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COMPUTERS AND AUTOMATION

CYBERNETICS • ROBOTS • AUTOMATIC CONTROL

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Vol. 2, No. 8

Who Will Man the New Digital Computers?

... John W. Carr III

Electronic Equipment Applied to Periodic Billing

... E. F. Cooley

Air-Floating: A New Principle in Magnetic Recording of Information

... Glenn E. Hagen

Roster of Organizations in the Field of Computers and Automation
(cumulative)

NOVEMBER, 1953

THE EDITOR'S OFFICE

Glossary of Terms. We intended to print in this issue the third and last section (F to Z) of the Glossary of terms in the field of computers and automation; but there was no room. It will be printed in the December issue. The first two sections were printed in the March issue (A, B) and the May issue (C to E). The whole glossary will be reprinted and available at 60 cents a copy, except that any person who subscribes to COMPUTERS AND AUTOMATION, or renews his subscription, on or before Dec. 15 will receive a free copy of the glossary reprint.

Employment Opportunities. Beginning in the December issue, we plan to devote regularly some space to employment opportunities in the field of computers and automation. Any organization who is looking for personnel is invited to send us a brief statement, on the basis of which entries will be constructed.

Correction. In the September issue, in the article by L. Wainwright, "Digital Computer Questionnaire", page 4 and 5 should be interchanged.

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Back Copies. Issues October, 1952, to date are available. Price $1.25 each; or a subscription may be specified to begin with a stated issue. See more information on page 35.

Manuscripts. We desire to publish articles that are factual, useful, understandable, and interesting to many kinds of people engaged in one part or another of the field of computers and automation. In this audience are many people who have expert knowledge of some part of the field, but who are laymen in other parts of it. Consequently, a writer should seek to explain his subject, and show its context and significance. He should define unfamiliar terms, or use them in a way that makes their meaning unmistakable. He should identify unfamiliar persons with a few words. He should use examples, comparisons, analogies, etc., whenever they may help readers to understand a difficult point. He should give data supporting his argument and evidence for his assertions. An article may certainly be controversial if the subject is discussed reasonably.

Ordinarily, the length should be 1000 to 4000 words, and payment will be $10 to $50 on acceptance. A suggestion for an article should be submitted to us before too much work is done. To be considered for any particular issue, the manuscript should be in our hands by the 5th of the preceding month.

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WHO WILL MAN THE NEW DIGITAL COMPUTERS?

John W. Carr, III, Univ. of Michigan, Willow Run Research Center,
Ypsilanti, Mich.

The new field begun with the construction of the first automatic and electronic digital computers hardly ten years ago -- the Harvard Mark I and the ENIAC -- has now moved into a stage of runaway growth. With its growth comes an immediate and pressing need for people to man the machines.

In addition to those first two digital machines, a vast number of improved editions have come off the drawing boards and later off construction lines since their inception. In government and university laboratories, there are operating: the EDVAC, an outgrowth of the ENIAC; three more Harvard machines; six computers of the so-called "Princeton" type, plus one more still being built; four SEAC-SWAC type machines; and Whirlwind I with at least one off-spring. Among the large commercial organizations, International Business Machines Corp. is now completing eighteen Type 701 computers and has announced a new magnetic drum computer Type 650 to be mass-produced. Eight UNIVAC systems are now in operation as a result of the efforts of Remington-Rand's Eckert-Mauchly Division. An unknown number of Engineering Research Associates' computers have been built; a recent program includes three on-line data-processing computers for a single installation.

At least six other organizations, with less expensive automatic computers, are producing one or more units of their products: Burroughs; Nuclear Development Associates with Hogan Laboratories; Elecom Division of Underwood Corporation; Consolidated Engineering Corporation; Monrobot Corporation, a subsidiary of Monroe Calculating Machines; and Computer Research Corporation Division of National Cash Register — to mention only a few.

The first large insurance company is now renting an experimental digital computer. A Detroit automotive firm, among others, has been studying automation of its data-handling for several years. The list of prospective, even perhaps committed, would-be users is larger than a casual observer would guess.

On the basis of the group of computers mentioned above, it can safely be said that by the end of the year there will be close to a hundred automatic, electronic, digital computers in operation. The number in succeeding years, provided there is no economic down-turn, staggers the imagination.

Now each of these machines may put to work anywhere from 5 to 50 engineers, mathematicians, and associated trained technical personnel. These people are needed merely to man them upon completion, and do not include those men and women who have been involved in their design and construction. So, a potential lack of trained personnel --already apparent to those persons now trying to staff computer installations -- becomes obvious. We need quick action to train the personnel without which a completed machine cannot run.

Four types of programs, in general, have been set up to bridge the gap. The first type has been instituted by commercial organizations seeking to sell or rent machines. IBM, Remington-Rand, and the CRC Division of National Cash Register, among others, have announced short training courses for incipient users of their own equipment.

Such programs are obviously useful, but have not yet been able to train enough personnel to man the machines being sold by those organizations only.

The second type is training on the job itself carried out by customers. Provided a trained nucleus staff is available, and time can be spared, this may prove satisfactory. Unfortunately, the economics of a costly digital computer often does not allow the lifting of a group's abilities in this way.

A third type of training has been attempted with success by several universities and technical institutions. Mass. Inst. of Technology, the University of Michigan, the University of Toronto, and Wayne University, among others, have offered special summer programs in digital computer techniques. Such intensive courses are useful in helping to establish the trained nucleus at a burgeoning computer installation; but so far they have not appeared to be able to train the masses of people that are really needed for adequate staffing.

The bulk of the training job must therefore fall, it appears, on the fourth type of training, regularly scheduled graduate and undergraduate courses and programs in universities. From these schools should issue a steady stream of mathematicians, computer engineers, assorted scientists, accountants, and business school graduates, all trained in several or many aspects of automatic digital computers.

Such a program has been begun. A prime essential for courses involving digital computation is the presence of some type of digital computer at the university. A number of universities and technical institutes now possess or have access to digital computers for training purposes. On the East Coast, M.I.T. with Whirlwind, Harvard with Mark I and Mark IV, and Columbia with access to the IBM-701, have this prime requirement satisfied. In the Mid-West, the Illinois computer at Urbana, the MIDAC at the University of Michigan, and the soon-to-be completed Wayne computer will be available to their respective institutions. On the West Coast the SWAC is located on the U.C.L.A. campus.

A slightly different pattern of cooperation between educational institution and industrial organization, but one that might well be copied, is the course being offered jointly by Trinity College and United Aircraft in Hartford using its Type 701 computer. Other organizations needing trained computer men might take this example of such a joint effort and reformulate it for their own local requirements.

The attitude of the Atomic Energy Commission toward university use of its computers at New York University, at Argonne Laboratories near Chicago, and in Oak Ridge, is not yet known. But if the pattern established with the machines for particle acceleration prevails, schools and universities may be able to use those computers in the New York, Chicago and Southeast areas.

Other schools have programs underway aimed at building or completing machines. The University of Pennsylvania's Moore School, University of Wisconsin, and University of California have unfinished projects. Purdue University is just beginning building a computer.

Even with the presence of a computer at a University, the job of establishing a curriculum in computers and computation has hardly begun. The burden falls heaviest on the mathematics and electrical engineering departments representing those who are to use and maintain machines; but other departments, ranging from astronomy to business administration, in each school need to adjust their teaching to what is indeed a revolutionary tool.

Courses in numerical analysis with specific applications need to be started by mathematics departments. Courses in machine programming must be begun, either by mathematicians or engineers or by several kinds of teachers working together. Courses in the use of machines must be set up by business administration groups and industrial engineers in the field of data-handling that is not mathematical. Courses in machine design, logic, and construction must be offered by the electrical engineering departments. Graduate programs need to be set up, either to give specific degrees in computation or else to give degrees in older fields with specialization in the use or design of computers.

Some schools have had previous experience in inaugurating training in the analog computation field. Most of the schools mentioned above have started one or more courses in the digital field within the last five years; several have broader plans covering the fields listed above.

If satisfactory use is to be made of the new data-processing tools in computation, business, and process control, it is the duty of men already in the computer field to encourage, in every way they can, adequate high-level training by colleges and universities, both those with facilities now available and those who later on may have such equipment. The rapid rate of growth of the digital computer field today depends in large measure on the availability of enough professionally trained persons to man the computers. The challenge is evident, and confronts American universities, governmental agencies, and private business, the three major societies (AIEE, IRE, and ACM), every one interested in the field. It must be met promptly.

ROSTER OF ORGANIZATIONS IN THE FIELD OF COMPUTERS AND AUTOMATION

(Cumulative, information as of Oct. 10, 1953)

The purpose of this Roster is to report organizations (all that are known to us) making or developing computing machinery, or systems, or data-handling equipment, or equipment for automatic control and materials handling. Each Roster entry when it becomes complete contains: name of the organization, its address, nature of its interest in the field, kinds of activity it engages in, main products in the field, approximate number of employees, year established, and a few comments and current news items. When we do not have complete information, we put down what we have.
Note: Beginning with the September issue, makers of components only have been transferred to another list, which see.

We seek to make this Roster as useful and informative as possible, and plan to keep it up to date in each issue. We shall be grateful for any more information, or additions or corrections that any reader is able to send us.

Although we have tried to make the Roster complete and accurate, we assume no liability for any statements expressed or implied.

This edition is a cumulative and up-to-date edition, except that some organizations previously mentioned have been omitted, either at their request or because their interest in the field is apparently no longer current.

Abbreviations

The key to the abbreviations follows:

Size

Ls	Large size, over 500 employees
Ms	Medium size, 50 to 500 employees
Ss	Small size, under 50 employees

(No. in parentheses is approx. no. of employees)

When Established

Le	Long established organization (1922 or earlier)
Me	Organization established a "medium" time ago (1923 to 1941)
Se	Organization established a short time ago (1942 or later)

(No. in parentheses is year of establishment)

Interests in Computers and Automation

Dc	Digital computing machinery
Ac	Analog computing machinery
Ic	Incidental interests in computing machinery
Sc	Servomechanisms
Cc	Automatic control machinery
Mc	Automatic materials handling machinery

Activities

Ma	Manufacturing activity
Sa	Selling activity
Ra	Research and development
Ca	Consulting
Ga	Government activity
Pa	Problem-solving
Ba	Buying activity

(Used also in combinations, as in RMSa, "research, manufacturing and selling activity")

*C This organization has kindly furnished us with information expressly for the purposes of the Roster, and therefore our report is likely to be more complete and accurate than otherwise might be the case. (C for Checking)

*A This organization has placed an advertisement in this issue of COMPUTERS AND AUTOMATION. For more information, see their advertisement. (A for Advertisement)

Addressograph-Multigraph Corp., 1200 Babbitt Road, Cleveland 17, Ohio, and elsewhere
*C, *A Addressograph sensing plates, composed automatically from punched tape, which will automatically list and total figures. Data written at speeds up to 30 forty-character lines per second; as a byproduct, codes automatically punched into punch cards. Electronic facsimile printers for high-speed copying of typed data contained in unit card records. Ls(8000) Le(1893) Ic RMSa

Alden Electronic and Impulse Recording Equipment Co., Alden Research Center, Westboro, Mass. *C, *A
Facsimile recording equipment and facsimile components. Ma SEE Alden Products Co.

Alden Products Co., 117 No. Main St., Brockton, Mass. *C, *A
General and specific components for digital and analog computing machinery; plug-in components, sensing and indicating components, magnetic delay line units, magnetic storage cores, etc. Ms(300) Me(1930) Ic RMSa

Alfax Paper and Engineering Co., Alden Research Center, Westboro, Mass. *C, *A
Electrosensitive recording papers. Ma SEE Alden Products Co.

R. C. Allen Business Machines, Inc., 678 Front Ave., Grand Rapids 4, Mich. *C
Adding machines, bookkeeping machines, cash registers, etc. Ls(1250) Me(1932) DIc RMSa

American Automatic Typewriter Co., 614 North Carpenter St., Chicago 22, Ill. *C
Pneumatically controlled programming and testing devices. Automatic selective typing equipment (Autotypist). Testing machines for typewriters, adding machines, calculating machines. Ms(100) Le(1868) Ic RMSa

Ampex Electric Corp., 934 Charter St., Redwood City, Calif. *C
Magnetic recording of data. Ms(350) Se(1944) Ic RMSa

ANelex Corporation, Concord, N. H., and 150 Causeway St., Boston 14, Mass. *C
High-speed printer (600 characters per second, numerical). Other input-output devices being developed. Ss Se DIc RMSa

Applied Science Corporation of Princeton, P. O. Box 44, Princeton, N. J. *C
Radio telemetering and automatic data conversion. Devices for automatic and semi-automatic reduction and analysis of telemetering and radar data. Analog read-in and read-out devices. Digital storage and computing elements. MADAM (Multipurpose Automatic Data Analysis Machine). Ms(85) Se(1946) DAc RCPMSa

Argonne National Laboratory, Chicago 18, Ill. *C
Maker of Oracle and Avidac automatic digital computers. Ls(3500) Me(1940) DIc RCGPa

Arma Corp., Old Country Rd., Garden City, L. I., N. Y. *C
Electronic fire-control apparatus. Analog computer components including resolvers, induction generators, etc. Basic weapon and control systems, navigational systems, precision remote control systems. Automatic machine tool and material handling systems. Analog computer components. Ls(6000) Le(1918) DASc RMSGPa

Armour Research Foundation, Illinois Inst. of Technology, 10 West 35 St., Chicago 16, Ill. *C
Magnetic recording. Digital, analog, and data-handling equipment. Automatic control machinery. Servomechanisms. Instrumentation. Ls(1200) Me(1936) DASCc RCPa

Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill. *C
Use analog computers; manufacture servomechanisms and automatic controls. Ms(400) Me(1930) SCc RMSPa

Audio Instrument Company, Inc., 133 West 14 St., New York 11, N. Y. *C, *A
Electronic, mechanical, and optical analog computers. Precision electronic instruments. Fire-control equipment, logarithmic amplifiers. Specialized passive computer which corrects for film non-linearity in photometric work, etc. Ss(10) Se(1949) DACSc RCSa

Automatic Electric Co., 1033 W. Van Buren St., Chicago, Ill. *C
Telephone equipment, relays, stepping switches, etc., for independent telephone companies and computing machinery companies. Automatic control components. Ls(6000) Le(1892) ICc RMSa

Automatic Signal Division, Eastern Industries, Inc., Norwalk, Conn.
Automatic volume-density traffic controllers. Me Ic RMSa

Automation Consultants, Inc., 1450 Broadway, New York 18, N. Y.
Consultants in electronic systems and devices, including automatic information-handling. Ss Se(1953) DSCc CPBa

Avion Instrument Corp., Div. American Car & Foundry Co., Paramus, N. J. *C
Digital and analog computing machinery. Magnetic recorders, amplifiers, electronic choppers, test equipment, servomechanisms, automatic control machinery, etc. Ms(130) Se(1946) RMSGa DAIc

Baird Associates, 33 University Road, Cambridge 38, Mass. *C
Spectroscopic analysis equipment. Scientific instruments. Analog devices and servomechanisms. Instrumentation for industrial control. Research in physical optics. Ms(170) Me(1936) AISc RMSa

Barber-Colman Co., Rockford, Ill. *C
Automatic controls, textile machinery, machine tools, etc. Barber-Colman-Stibitz digital computer, operating. Ls(3000) Le Dc RMSa

Beckman Instruments Inc., South Pasadena, Calif. *C
"Analog-digital" converter. Special purpose control computers. EASE computer (Electronic Analog Simulating Equipment). Ls(1000) Me(1934) DAc RMSa

Bell Telephone Laboratories, Murray Hill, N. J., and 463 West St., New York, N. Y. *C
Automatic switching. Bell general purpose computers (relay and electronic, digital and analog) for government use and company's own use. Ls Le DAc RGPa

Bendix Aviation Corp., Computer Div., 5630 Arbor Vitae St., Los Angeles 45, Calif. *C
Digital information processing systems for military and industrial use. Digital differential analyzer. Ms(59) Se(1952) DAc RMSa

Bendix Aviation Corp., Pacific Div., North Hollywood, Calif. *C
Telemetering systems. Digital controls and components. Ms(50) Se(1952) Ic RMSa

Benson-Lehner Corp., 2340 Sawtelle Blvd., West Los Angeles 64, Calif. *C
Automatic and semi-automatic devices (both analog and digital) for computing, data analyzing, data reduction, optical measuring, guided missile analysis, etc. Commercial applications of industrial control devices. Ms(65) Se(1950) DAc RCMSa

Berkeley Division, Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.
EASE computer (Electronic Analog Simulating Equipment) for solving equations, simulating systems, etc. Se Ac RMSa

Edmund C. Berkeley and Associates, 36 West 11 St., New York 11, N. Y., 19 Milk St., Boston 9, Mass., and elsewhere. *C
Small one-of-a-kind computers (Simon) and robots (Squee). Others under development. Courses, publications. Publisher of "Computers and Automation". Ss(14) Se(1948) Dc RCMSa

Birkbeck College, University of London, London, England.
Maker of ARC, APEXC, and SEC digital computers. DAc RCPa

Boeing Airplane Co., Seattle 14, Wash.
BEAC, Boeing Electronic Analog Computer. Servomechanisms and analog computing devices. Ls Le ASc RMSa

British Tabulating Machine Co., Ltd., 17 Park Lane, London W. 1, England. *C
Punched card machines. Ls(4500) Le(1908) Dc RCPMSa

Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio (formerly Brush Development Co.) *C
Recording analyzers. Magnetic tape, heads, and drums. Computer components. Ls(1300) Le(1921) Ic RMSa

Bull S. A. Compagnie des Machines, 94 Avenue Gambetta, Paris, France.
Punch card machines. Development of electronic computer components. Ls(3000) Le Dc RMSa

Bureau of the Census, Washington 25, D. C. *C
Tabulation of statistical data by special machines designed and built for own use, by commercial punch-card equipment, and by electronic computing system (the Univac). Ls(1100 in Machine Tabulating Division) Le(1890 in punch card field) Dc Ga

Burroughs Corporation (formerly Burroughs Adding Machine Co.), 6071 Second Avenue, Detroit, Mich. -- headquarters; Research Division -- 511 No. Broad St., Philadelphia, Pa.; and elsewhere. *C, *A
Adding machines, bookkeeping machines, etc. Research division has made Burroughs Laboratory computer, an electronic digital test computer, assembled from pulse control units. Fast-access magnetic-core memory. Pulse control components, servomechanisms. This company owns Control Instrument Co. Ls(18,000) Le(1896) DSc RMSPa

Clary Multiplier Corp., 408 Junipero St., San Gabriel, Calif. *C
Adding and multiplying machines, cash registers, electronic counters, automatic read-out devices for electronic computers, data-reduction apparatus, analog-to-digital converters. Ls(1800) Me(1939) DAc RMSa

Commercial Controls Corp., 1 Leighton Ave., Rochester 2, N. Y.
Mailroom equipment. "Flexowriter" electric typewriter with punched paper tape control. Ls Le Ic RMSa

Commonwealth Scientific and Industrial Organization, Radiophysics Division, Sydney, New South Wales, Australia
Maker of CSIRO Mark I electronic digital computer of Inst. for Advanced Study type. DAc RCGPa

Computation Centre, Univ. of Toronto, Toronto, Canada *C
Digital, electronic computers. Now operating: a Ferranti Electric automatic computer; IBM installation. Ss(15) Se(1947) RPa Dc

Computer Control Co. Inc., 106 Concord Ave., Belmont, Mass. *C
Computers and computer components, digital data-handling systems, solid delay line acoustic memory, computer test equipment, specialized systems and instrumentation. Ss(11) Se(1945) Dc RMSCa

Computer Corp. of America, 149 Church St., New York 7, N. Y.
Electronic analog computer. Se Ac RMa

Computer Research Corp. of California, subsidiary of National Cash Register Company, 3348 West El Segundo Blvd., Hawthorne, Calif. *C
Digital computers, data processing machines, decimal digital differential analyzers, computer components, magnetic components. Computing systems (general and special purpose, business or scientific). CRC102-A general purpose computer and other computers. Ms(346) Se(1950) Dc RCMSa

Computing Devices of Canada, Lim., P. O. Box 503, Ottawa, Ont., Canada. *C
Digital and analog computers, automatic navigation systems, electronic laboratory test equipment, simulators, servomechanisms. Research and development in instrumentation, automatic control, business sorting, scientific sorting, systems analysis. Ms(120) Se(1948) DASCc RCPMSGa

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. *C, *A
Automatic electronic digital computers (Model 30-201). Digital and analog data handling and conversion systems (Sadic, Millisadic, etc.). Automatic translator magnetic tape to punched card. Ls(900) Me(1937) Dc RMSa

Consolidated Vultee Aircraft Corporation, San Diego 12, Calif. *C
Output devices for telemetering and computing systems. The Charactron, equipment including a cathode-ray tube that at high speed converts analog or coded information into alphabetic or numeric light images on the screen. Ss(20 on this project) Se(1951 on this project) Ic RMSa

Control Instrument Co., 67 35th St., Brooklyn, N. Y. *C
Fire-control equipment. 1000-line-a-minute tabulator. Digital and analog machines and components. Now a subsidiary of Burroughs Corporation. Ls(1200) Me(1934) DAc RMSa

Curta Calculator Co., 3851 West Madison St., Chicago 24, Ill.
Eight-ounce, hand-powered, rotary "brief-case" calculator; adds, subtracts, multiplies, divides; totals to 15 decimal places; made in Lichtenstein. Ss(10) Se(1952) Dc Sa

Daco Machine Co., Brooklyn, N. Y.
Computing controls for machine tools. Cc RMSa

Davies Laboratories, Inc., 4705 Queensbury Road, Riverdale, Md. *C
ANSER, analog simulator and computer. Automatic data-reduction equipment. Magnetic tape recorders. Ms(85) Se(1946) Ac RMSCa

The de Florez Co., 116 East 30 St., New York, N. Y.
Magazine subscription fulfillment problem, etc. Ss Se DAc RCa

Digital Control Systems, Inc., Top of Mount Soledad, P. O. Box 779, La Jolla, Calif. *C
Design and construction of laboratory models of many types of digital computers and control systems. Ss Se(1951) DCc RMSa

Digital Products Inc., 7852 Ivanhoe Ave., La Jolla, Calif. *C
Digital computers, etched circuitry, magnetic heads, memory drums. Ss Se(1952) DIc RMSa

Eckert-Mauchly Division, Remington Rand, Inc., 3747 Ridge Ave., Philadelphia, Pa., and elsewhere. *C
All purpose electronic digital computers. Univac Factronic System. Ls(600)? Se(1946) Dc RCMSa SEE also Remington Rand, Inc.

Thomas A. Edison, Inc., Instrument Division, 22 Lakeside Ave., West Orange, N. J. *C
Automatic control components, time delay relays. Ms(360 in Division; 4000 in company) Le(1888) Ic RMSa

Electronic Associates, Inc., Long Branch, N. J. *C
General purpose precision analog computers, special purpose analog computers, analog computer components, digital-to-analog converter, digital plotting system (Dataplotter). Automatic control of all machine tools. Ms(364) Se(1945) DACc RMSa

Electronic Computer Div. of Underwood Corp., 35-10 36th Ave., Long Island City 6, N. Y. *C
Constructing five types of electronic digital computers (ELECOM-100, -120, -125, -200, and a data-handling computer). Delay lines, decade delay lines, pulse transformers, magnetic recording heads, magnetic drums, D.C. plug-in amplifiers. Ms(200) Se(1949) Dc RMSa

Electronic Engineering Co., 180 South Alvorado St., Los Angeles, Calif.
Analog computing machinery. Analog-to-digital-to-analog converters. Polar-to-rectangular-to-polar converters. Servomechanisms. Me Se DAc RMSa

Elliott Addressing Machine Co., 199 Albany St., Cambridge 39, Mass.
Addressing stencils, with selection controlled by punched holes in cardboard margin. Ls Le Ic RMSa

Elliott Bros. (London) Ltd., Century-Works, Lewisham, London S.E. 13, England, and Research Laboratories, Elstree Way, Borehamwood, Herts., England. *C
Digital and analog computers; servomechanisms. Ls(2000) Le(1800) DASc RMSa

Engineering Research Associates, Div. of Remington Rand, Inc., 1907 West Minnehaha Ave., St. Paul, Minn., and 510 18th St. South, Arlington, Va. *C
Digital computers; ERA 1101 and 1103 electronic digital computers; the Logistics Computer. Magnetic storage systems, including magnetic heads, magnetic drums, etc. Shaft-position indicator systems, self-recording accelerometers, analog magnetic recording systems, data-handling equipment, special purpose communications equipment, pulse transformers. Ls(750) Se(1946) Dc RMCPSa SEE also Remington Rand, Inc.

Engineers Northwest, 100 Metropolitan Life Bldg., Minneapolis 1, Minn. *C
Test-scoring machines and equipment. Ss(20) Se(1945) DAc RCMa

English Electric Co., Stafford, England. *C
Manufacturer of fully engineered versions of ACE (see National Physical Laboratory). Ls Le DIc RMSa

E-Z Sort Systems, Ltd., 45 Second St., San Francisco 5, Calif.
Edge-punched cards for filing and sorting data. Ms(250) Me(1935) Ic RCMa

Fabrica Addizionatrice Italiana S. A., Viale Umbria 36, Milan, Italy.
Desk calculators to add, subtract, multiply, divide, print. Dc RMSa

Facit, Inc., 500 5th Ave., New York 36, N. Y. (subsidiary), Stockholm, Sweden (headquarters), and elsewhere. *C
Calculators, adding machines, typewriters, etc. (in 1390 A. D., copper mining). Ls(4000) Le(1390 A.D.) Dc RMSa

Federal Telephone and Radio Corp., Clifton, N. J.
Equipment for airline reservation problem. Ic RMSa

Felt and Tarrant Mfg. Co., Comptometer Div., 1735 North Paulina St., Chicago 22, Ill. *C
Adding-calculating machines, key-driven, electric and non-electric. Comptometer. Ls(1700) Le(1886) Dc RMSa

Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y., agent for Ferranti Electric Ltd., Moston, England, and Mount Dennis, Toronto, Canada. *C
Complete electronic digital computers (Ferranti; also called "Manchester Universal Electronic Computer"). High-speed photoelectric tape reader, which can read up to 200 characters per second. Magnetic drum and electrostatic storage components, etc. Ls(10,000) Le(1896) Dc RMSa

Ford Instrument Co., Div. of The Sperry Corporation, 31-10 Thomson Ave., Long Island City 1, N. Y. *C
Gun fire control apparatus. Analog computers and components, magnetic amplifiers, servo motors, differential and integrator elements. Instruments for shipborne and airborne armament and navigational control. Ls(3800) Le(1915) ASc RMPCSa

The Franklin Institute Laboratories for Research and Development, 20th St. & Benjamin Franklin Parkway, Philadelphia 3, Pa. *C
Fire control equipment. Special purpose analog computers, large and small scale. Digital computer components. Prototype construction. Ms(325) Se(1946) DAc Ra

Friden Calculating Machine Co. Inc., San Leandro, Calif. *C
Desk calculating machines. Computyper. Ls(2000) Me(1934) Dc RMSa

General Controls, 801 Allen Ave., Glendale 1, Calif. *C
Automatic controls (pressure, temperature, level, flow). Ls Cc RMSa

General Electric Co., Syracuse, N. Y., and Schenectady, N. Y. *C
Digital and analog, electric and electronic, computers and analyzers. Network analyzers. Automatic electronic digital computers, OARAC. Ls(c.220,000) Le Ic RMSa

Gerber Scientific Instrument Co., 89 Spruce St., Hartford 1, Conn. *C
Graphical computer "Graphanalogue". Ss Se(1946) Ac RMSa

Goodyear Aircraft Corp., Dept. 65A, Akron 15, Ohio. *C
Goodyear electronic differential analyzers. (GEDA line of analog computing equipment). Ls Me Ac RMSa

Haller, Raymond, and Brown, Inc., State College, Pa. *C
Electronic digital computer for solution of up to 1200 simultaneous equations, using magnetic drum and tape. Research and development on computer components, analog computers, electronic and electromechanical systems. Engineering analysis, operations research, electronic development. Ms(150) Se(1947) DAc RMSa

Hamann Calculating Machine Co., 2118 Land Title Building, Philadelphia 10, Pa.
Adding, subtracting, multiplying desk calculators. Dc MSa

Harvard Computation Laboratory, Cambridge 38, Mass. *C
Harvard Mark I, II, III, IV calculators for Navy, Air Force, and own use. Ms Se Dc RPMa

Hillyer Instrument Co., 54 Lafayette St., New York, N. Y. *C
Simulators, servomechanisms, sensing, computing, and actuating systems. Automatic machine controls. Ms(100) Se(1945) DAICc RMSa

Hogan Laboratories, 155 Perry St., New York, N. Y. *C
Facsimile machines. Digital, high-speed printers and computers. Manufacturing the Circle Computer. Ms(60) Me(1929) Dc RMSa

Hughes Research and Development Laboratories, Hughes Aircraft Co., Culver City, Cal.
Automatic data handling systems. Industrial process control systems. Small powerful electronic digital computer. Fire-control equipment. Aircraft control. Navigation systems. Ls Me DAc RMSa

Institut Blaise Pascal, Laboratoire de Calcul Analogique, 155, rue de Sèvres, Paris 15, France. Ac RPa

Institut Blaise Pascal, Laboratoire de Calcul Mécanique, 25, Avenue de la Division LeClerc, Chatillon-sous-Bagneux (Seine), France *C
Constructing a digital calculator. Ss(9) Me(1939) Dc RPa

Institute for Advanced Study, Princeton, N. J.
"Maniac", big fast electronic digital calculator, for own use. Dc RPMa

Intelligent Machines Research Corp., 134 So. Wayne St., Arlington, Va. *C, *A
Devices for reading characters on paper, etc. Pattern interpretation equipment. Sensing mechanisms. Digital computer elements. (Ss(10) Se(1951) Dc RCMSa

International Business Machines Corp., 590 Madison Ave., New York 22, N. Y. and elsewhere. *C
Punch card machines. Type 650, Magnetic Drum Calculator. IBM electronic Data Processing Machines, Type 701 (magnetic tape, magnetic drum, electrostatic storage). Card Programmed Calculator. Electronic calculating punch Type 604. Data processing equipment. Process control equipment. Automatic Source Recording Equipment. Ls(42,000) Le(1911) Dc RMSa

International Telemeter Corp., 2000 Stoner Ave., Los Angeles 25, Calif. *C
Systems and devices for clerical and control applications. High-capacity rapid-access ferrite core memories. High-density photographic information storage. Metered and piped television. Ms(100) Se(1951) RMSa

International Telephone and Telegraph Corp., 67 Broad St., New York, N. Y.
Equipment for airline reservation problem. Fully automatic pneumatic tube system, by dialing. Ic RMSa

Jacobs Instrument Co., 4718 Bethesda Ave., Bethesda 14, Md. *C
High-speed small, compact digital computers (Jaincomp A, B, B1, C). Pulse transformers, delay lines, magnetic storage systems. Input and output devices. Complete instrument systems. Ss(30?) Se(1948) DASCc RMSa

Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena 3, Calif. *C
Analog, digital, and data-handling systems. Ls(500; about 50 on computers) Me(1940) DAc RCPa

Ketay Manufacturing Co., 555 Broadway, New York 12, N.Y., and elsewhere *C
Automatic control systems; synchros, servo motors, resolvers; magnetic, electronic, and resolver amplifiers. Electronic equipment. Servomechanisms. Ls(1700) Se(1943) CISc RMSa

A. Kimball Co., 307 West Broadway, New York 13, N.Y. *C
Machine for printing and punching garment tags. Input mechanisms. Ms(200) Le(1876) Ic RMSPa

Laboratory for Electronics, 51 Pitts St., Boston 14, Mass. *C, *A
Analog and digital computers, special computers to suit customer requirements, delay lines (mercury, quartz), plug-in packages for computer applications, etc. Ls(700) Se(1946) DAc RMSa

Lanston Monotype Machine Co., Barrett Adding Machine Div., 24th & Locust Sts., Phila. 3, Pa.
Adding, subtracting, and printing, desk calculators. Dc RMSa

Leeds and Northrup, 4901 Stenton Ave., Philadelphia 44, Pa. *C
Automatic recorders and controls. Ls(3150) Le(1899) Cc RMSa

Librascope, Inc., 1607 Flower St., Glendale 1, Calif. *C
Mechanical and electrical analog computers; primarily special-purpose. Ls(600; about 30 on computers) Me(1937) DASc RMSa

Arthur D. Little, Inc., 30 Memorial Drive, Cambridge 42, Mass. *C
Analog digital converter, "Automatic Digital Recorder of Analog Data" (ADRAD). Conversion and input devices. Ls(700) Le(1886) Ic RCa

Logabax Co., 12 rue de l'Arcade, Paris, France
Collaborating with Institut Blaise Pascal on computing devices. DIc RMSa

Logistics Research Inc., 141 So., Pacific Ave., Redondo Beach, Calif. *C
Digital computers and computing systems (ALWAC). Data-reduction and data-handling systems, input and output equipment, automatic graph-plotters, large-scale magnetic memories with "air-floated" magnetic heads, etc. Ss(35) Se(1952) DIc RMSa

W.S. Macdonald Co., Inc., 33 University Rd., Cambridge, Mass. *C
Digital business machines using magnetic drum memory for 10,000 registers; etc. Ss(20) Se(1946) Dc RMSa

Marchant Calculators, Inc. (formerly Marchant Calculating Machine Co.), Oakland 8, Calif. *C
Desk calculators. Marchant-Raytheon Binary-Octal desk calculator. Ls(1500) Le(1913) Dc RMSa

Marchant Research, Inc., Oakland 8, Calif. (formerly Physical Research Laboratory, Pasadena, Calif.) (subsidiary of Marchant Calculators, Inc.) *C
Electronic digital computers (including Miniac). Magnetic storage systems, magnetic heads, data-handling equipment including analog-to-digital converter, computer components. Ss Se Dc RMSa

Massachusetts Institute of Technology, Digital Computer Laboratory; also Center of Analysis; Cambridge 39, Mass.
"Whirlwind" electronic digital computer. Ms(300+) Se(1945?) Dac RCPa

Mathematisch Centrum, Amsterdam, Netherlands
Relay computer in use; electronic computer under construction. Dc RCPa

The W.L. Maxson Corp., 460 West 34 St., New York, N.Y., and elsewhere
Servomechanisms, analog computers, and digital computers for fire control, navigation, etc. Automatic control machinery. Ls(3000) Me(1935) DASCc RMSa

Mechanical Handling Systems, Inc., 4600 Nancy Ave., Detroit 12, Mich.
Automatic conveyors for moving separate articles, large or small, heavy or light, etc., in manufacturing process. Ls Me Mc RMSa

Mellon Institute of Industrial Research, Multiple Fellowship on Computer Components, Univ. of Pittsburgh, Pittsburgh 13, Pa. *C
Ss(6) Se(1950) Dc RCa

Mid-Century Instrumatic Corp., 611 Broadway, New York 12, N.Y.
Components for electronic analog computers: function-generators, multipliers, etc. Ss(20) Se(1947) Ac RMSa

Minneapolis-Honeywell Regulator Co., Industrial Division, 4580 Wayne Ave., Philadelphia 44, Pa. *C
Automatic controllers. Brown Instruments. Servo components used in computers. Recording and indicating instruments and control equipment, etc. Ls(3500) Le(1859) Cc RMSa

Minnesota Electronics Corp., 47 West Water St., St. Paul 1, Minn. *C
Digital and analog computers. Magnetic components, magnetic decision elements. Data reduction systems, telemetering. Ss(35) Se(1946) DAIc RMSa

Monrobot Corp., Morris Plains, N.J. *C, *A
Monrobot automatic electronic digital computers. Subsidiary of Monroe Calculating Machine Co. Ss(32) Se(1952) Dc RMSa

Monroe Calculating Machine Co., Orange, N.J., and elsewhere. *C
Desk calculating machinery for adding, calculating, and bookkeeping. SEE Monrobot Corp. Ls(4000) Me(1925) Dc RMSa

Moore School of Electrical Engineering, Univ. of Pennsylvania, Philadelphia, Pa. *C
Place where Eniac and Edvac electronic digital computers were constructed. Constructing MSAC (Moore School Automatic Computer). Analog and digital equipment. Ms(80) Me(1923) DAc RCPMa

Mountain Systems, Inc., 94 Lake St., White Plains, N.Y.
Data processing systems and digital computer systems. Ss Se Dc RMSCa

National Bureau of Standards, Division of the National Applied Mathematics Laboratories: *C
(1) Computation Laboratory, Washington 25, D.C.
SEAC, Bureau of Standards Eastern Automatic Computer. Ms(100) Me (1938) Dc RCPGa
(2) Institute for Numerical Analysis, 405 Hilgard Ave., Los Angeles 24, Calif.
SWAC, Bureau of Standards Western Automatic Computer. Ms(100) Se (1947) Dc RCPGa
(3) Machine Development Laboratory, Washington 25, D.C.
Specifications development. Systems analysis. Ss(10) Se(1947) Dc RCGa

National Bureau of Standards, Electronics Division, Electronic Computers Laboratory, Washington 25, D.C. *C
Digital computers, data processing systems, input-output devices. Storage elements, transistors, diodes, delay lines, etc. Have designed and assembled Seac and Dyseac electronic digital computers, etc. Ms(110) Se(1946) Dc RCMBGa

National Cash Register Co., Main and K Sts., Dayton, Ohio, and elsewhere. *C
Cash registers. Accounting-bookkeeping machines. Adding machines. Purchaser of Computer Research Corporation. Ls(33,000) Le(1884) Ic RMSa

National Physical Laboratory, Electronics Section, Teddington, Middlesex, Eng. *C
Digital computers and associated equipment. Designer and builder of the Pilot Model of ACE (Automatic Computing Engine -- high-speed, electronic, digital). Collaborates with English Electric Co. Ls(1000;Elecnc Sec 25) Le(1900; Elecnc Sec 1948) DIc RCPMa

Northrop Aircraft Co., Hawthorne, Calif.
Computing center; develops, maintains, operates own computing equipment. Data reduction and analysis. Development of computing systems on order. Ms(70 this project) Se(1950 this project) DAc RCPa

Nuclear Development Associates, 80 Grand St., White Plains, N.Y. *C
Design and development of Circle Computer. Associated with Hogan Laboratories. Ss Se DIc RMSa

Olivetti Corp. of America, 580 Fifth Ave., New York 36, N. Y., and associated companies elsewhere. *C

Desk adding, calculating, and printing machines. Fully automatic printing calculators. Ls(6000) Le(1908) Dc RMSa

Panellit, Inc., 6312 North Broadway, Chicago 40, Ill.

For automatic control: coordinated and graphic control panels for process variables; multiple-point scanning systems; annunciator systems. Cc RMSa

Pennsylvania State College, X-Ray and Solid State Lab., Dept. of Physics, State College, Pa. *C

X-RAC computer for crystal electron density functions. S-FAC for structure factor calculations. R-PAC (recorder playback computer) for Patterson function interpretations. Ms(55) Se(1947) Ac RPa

George A. Philbrick Researches, Inc., 230 Congress St., Boston 10, Mass. *C

Philbrick electronic analog computing equipment and components. Ss(5+) Se(1946) Ac RCMSa

Photon, Inc., 58 Charles St., Cambridge 38, Mass. *C

Machinery for composing type by photographs. First photographically-composed book has been published. Ms(100) Me(1940) DIc RCMSa

Pitney-Bowes, Inc., Stamford, Conn. *C

Postage meters. Tax-stamping meters. "Tickometer" counting and/or imprinting machines. Ls(3000) Le(1920) Ic MSa

Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. *C

Electronic counters. Magnetic tape handler; digital printer; electronic tag reader. Random access memory. High speed printer ("flying typewriter"). Analog-to-digital converter. Ms(100) Se(1942) Dc RMSa

Powers-Samas Accounting Machines Ltd., England.

Punch card tabulating equipment using small, medium, and standard cards. Agency is Underwood Corp., which SEE. Ls(6000) Le(1916) DIc RMSa

Productions Electroniques, 8, rue Laugier, Paris 17, France

Collaborating with Institut Blaise Pascal on magnetic recording devices. Ic RMSa

Radio Corp. of America, Laboratories, Princeton, N. J.; RCA Victor Div., Camden, N.J. and Harrison, N. J. *C

Selective electrostatic storage tube (formerly Selectron), Radechon, Graphecon, Williams Tube, Time Interval Counter; computer systems. Magnetic matrix memory. Ls Le Ic RMSa

The Rand Corporation, 1700 Main St., Santa Monica, Calif. *C

Constructing an electronic digital computer of the type of the Institute for Advanced Study. Ls(500) Se(1946) DAIc RCPa

Raytheon Manufacturing Co., Waltham, Mass. *C, *A

Electronic digital computer systems for scientific applications (RAYDAC), and for general accounting and data-handling applications. Tape-handling mechanisms, magnetic heads, magnetic shift registers, and other computer components and sub-systems. Computing service to analyze problems in applied mathematics, in engineering, and in industrial logistics by digital computer. Radar, fire control, microwave equipment, etc. Ls(20,000) Me(1925) DAc RMSa

Reeves Instrument Co., 215 East 91 St., New York, N. Y.

Fire-control equipment. "REAC" electronic analog computers. Ls Me Ac RMSa

Remington Rand, Inc., 315 4th Ave., New York 10, N. Y., and elsewhere. *C, *A

Punched card machines, office machines, electronic digital computing systems (Univac Factronic System, ERA 1101, ERA 1103), servomechanisms. Ls (30,000; 1800 on computers) Le DASc RCMSa SEE also Eckert-Mauchly Division, and Engineering Research Associates Division.

Robotyper Corporation, Hendersonville, N. C.
Automatic typing equipment that can be associated with any electric typewriter, using a record roll pneumatically operated. Ic RMSa

Scientific Computing Service, Ltd., 23 Bedford Sq., London, W.C. 1, England. *C
Ss(16) Me(1938) DAIc CPa

Servo Corporation of America, New Hyde Park, N. Y. *C
Servomechanisms. Automatic controls. Analysis and synthesis for controls manufacturers. Temperature controls by infra-red radiation. Industrial controls. Servo components and test equipment. Analog and digital computers. Ms(230) Se(1946) DASCc RMSa

Servomechanisms, Inc., Garden City, N. Y., and elsewhere. *C
Automatic electronic and electro-mechanical control systems, instrumentation, and components. Analog computers. Ls(700) Se(1946) ASCc RMSa

Société d'Electronique et d'Automatisme, 138 Blvd de Verdun, Courbevoie, Seine, France *C
Analog and digital computers. Servomechanisms, electronic equipment for machine tools. Ms(300) Se(1948) DASc RMSa

Sperry Gyroscope Co., Great Neck, N. Y. *C
Ordnance; fire-control equipment. Automatic controls. Navigation equipment, sea and air. Radar, Loran, gyrocompasses, precision instruments. Ls(18,000) Le(1910) Ac RMSa

Swedish Board for Computing Machines, Drottninggatan 95A, Stockholm, Sweden. *C
Planned the relay computer BARK (Binary Automatic Relay "K"omputer) which was then built by the Royal Telegraph Administration. BARK has run commercially since July 1950. Planning and constructing an electronic computer of the Princeton type. Ss(30) Se(1949) Dc RMCPa

Sylvania Electric Co., Radio and Television Division, 70 Forsyth St., Boston 15, Mass. *C, *A
Electronic digital computers using printed circuit techniques. Subassemblies of diodes and triodes. Ls(2200; this division, 190) Le(1901; this division, 1945) DAc RMSa

Taller and Cooper, 75 Front St., Brooklyn, N. Y. *C
Data recording and conversion systems, printers, perforators. Function generators, computers. Toll equipment for bridges, highways, turnpikes. Ms(250) Me(1926) DIc RMSa

Tally Register Corp., 5300 14th Ave., N. W., Seattle 7, Wash. *C
Special-purpose business machines and instruments. High-speed data-reduction system for telemetering applications; electrosensitive tape recorders and readers; tape-to-card converters; binary-decimal converters; data input devices. Ss Se DICMc RMSCa

Taylor Instrument Co., Rochester, N. Y.
Automatic controllers. Ls Le Cc RMSa

Technitrol Engineering Co., 2751 No. 4 St., Philadelphia 33, Pa. *C
Computing and control equipment. Complete digital systems. Components, pulse transformers. Electrical and acoustic delay lines. High-speed memories. Time serial computers. Ms(75) Se(1947) DAc RMSa

Telecomputing Corp., 133 E. Santa Anita Ave., Burbank, Calif. *C
Automatic data reading, recording, and plotting equipment (Universal Telereader, Telecordex, Teleducer, Contact Telereader, Teleplotter). Ms(250) Se(1947) DCMc RMSPa

Teleregister Corp., 157 Chambers St., New York 7, N. Y. *C
Digital and analog special purpose computers. Data inventory systems for special applications -- travel reservations, flight data processing, stock market quotations, etc. Magnetronic Reservisor, in use at American Airlines' reservations center. Magnetronic stock quotation system now in use at Toronto Stock Exchange. Associated with Western Union. Ms(275) Me(1928)

Teletypesetter Corp., 7 Dey St., New York, N. Y.
Machines that set linotype at a distance. Ic RMSa

John E. Thompson and Associates, 7210 So. Yates Ave., Chicago 49, Ill. *C
Ss(10) Se(1946) Ac Ma

Ultrasonic Corp., 61 Rogers St., Cambridge 42, Mass. until Dec. 31, 1953; thereafter 640 Memorial Drive, Cambridge, Mass. *C
Automatic control using feedback: development, equipment. Computing controls for machine tools. Etc. Ls(700) Se(1945) DASc RMSa

Underwood Corp., One Park Ave., New York 16, N. Y.; General Research Lab., 56 Arbor St., Hartford 6, Conn.; and elsewhere. *C
Accounting machines, adding machines, typewriters. Elliott-Fisher and Sundstrand machines. Underwood electric typewriters, used in Harvard Mark II calculator. ELECOM electronic computers. SEE Electronic Computer Division. Ls(company 10,000; laboratory, 100) Le(1895) DIc RMSa

Union Switch and Signal Co., Division of Westinghouse Airbrake, Pittsburgh 18, and Swissvale, Pa.
Railroad signaling and control systems. Ls(4000) Le Ic RMSa

U. S. Air Force, Aeronautical Research Laboratory, Computation Branch, Wright Air Development Center, Wright-Patterson Air Force Base, Dayton, Ohio (formerly Office of Air Research) *C
Assembling a computing laboratory. Has Oarac. Ms Se(1946) DACMc GRPa

U. S. Air Force, Cambridge Research Center, 230 Albany St., Cambridge 39, Mass.
Developed the ABC (Automatic Binary Computer). Has a Computer Research Corp. 102. Ms Me DIc Ga

U. S. Air Force, Inst. of Technology, Wright-Patterson Air Force Base, Dayton, Ohio *C
Electronic strategy machine, conceived by L. I. Davis. Philbrick and Reac equipment on hand. Ms(300) Se(1946) DAIc Ga

U. S. Army, Ballistic Research Laboratories, Aberdeen Proving Ground, Aberdeen, Md. *C
Has Bell, Edvac, Eniac, Ordvac computers and others. Developing supplementary and modernizing components. Ms Le DAc Ga

U. S. Naval Proving Ground, Computation and Ballistics Department, Dahlgren, Va. *C
Has Harvard Mark II relay and Mark III electronic digital computers. Digital and analog machines. Ms(116) Se(1942) DAc PRGa

U. S. Naval Research Laboratory, Washington 25, D. C. *C
Making NAREC digital computer. Ls(3000) Me(1923) DASc RCGPa

Univ. Mathematical Laboratory, Free School Lane, Cambridge, England.
Has EDSAC electronic digital calculator. Dc RCPa

Univ. of California, Berkeley, Calif. *C
Constructing CALDIC, California Digital Computer. Ss(10) Se(1947) DAc RPa

University of Illinois, Urbana, Ill.
Built electronic digital computer Ordvac for Ballistic Research Laboratory, Aberdeen. Has finished computer Illiac on same design, but with faster input-output using a photoelectric reader. Dc RCPa

University of Manchester, Mathematical Laboratory, Manchester, England. *C
Has automatic electronic digital computer built by Ferranti Electric, Ltd. This laboratory developed much of the design. Ss(8) Se(1947) Dc RPa

Univ. of Michigan, Willow Run Research Center, Willow Run Airport, Ypsilanti, Mich. *C
Digital computers, both special purpose and general purpose, including Midac; electronic and electromechanical analog computers; simulators. Data-processing systems; analysis and computation using Midac; instruction in programming and numerical methods; simulation. Ls(500) Se(1946) DAc RCPa

University of Sydney, Dept. of Electrical Engrg., Section of Mathematical Instruments, Sydney, New South Wales, Australia
Analog computers. Ac Ra

Victor Adding Machine Co., 3900 No. Rockwell St., Chicago 18, Ill. *C
Adding machines. Ls(1600) Le(1918) Dc RMSa

Wallind-Pierce Corp., 1928 Pacific Coast Highway, Lomita, Calif. *C
Digital-to-analog, and analog-to-digital translators. Digital and analog computers, magnetic amplifiers, etc. Ss(18) Se(1951) DASc RCMSa

Wang Laboratories, 296 Columbus Ave., Boston 16, Mass. *C
Magnetic delay-line memory units. Digital signal generators. Multiple scalers. Static magnetic memory systems and other devices. Ss Se(1951) Dc RCMSa

The George Washington Univ., Logistics Research Project, 707 22nd St., Washington 7, D. C. *C
ONR relay computer with magnetic drum memory. Data-handling machines. Fast output. ONR electronic digital computer with magnetic drum memory. Ss Se(1949) Dc SRCPa

Watson Scientific Computing Laboratory, 612 West 116 St., New York, N. Y. *C
The pure science department of International Business Machines. Simultaneous linear equation solver. Astronomical plate measuring machine. IBM punch card machines. Ms(75) Se(1945) DAc RCPa

Wayne University, Cass Ave., Detroit 1, Mich. *C
Computation laboratory. 5300 word magnetic drum computer built of Burroughs pulse control equipment. Has Mass. Inst. of Tech. Differential Analyzer No. 1. Acquiring Bendix digital differential analyzer. Ss(20) Se(1950) DAc Ra

Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4, Mich.
Conveyor engineers and manufacturers. Mc RCMSa

Weems System of Navigation, 227 Prince George St., Annapolis, Md.
Automatic navigation systems. Me Ic RCPMSa

Westinghouse Electric Corp., Industry Engineering Dept., East Pittsburgh, Pa. *C
Analog computers for: mechanical and electrical problems; regulating systems; servomechanism behavior; flow of heat, oil, or gas; other purposes. DC and AC calculating boards. ANACOM computer. Ls Le DASc RMSCPa

Zator Co., 79 Milk St., Boston 9, Mass. *C
Equipment and systems, for coding, filing, and finding information (Zatocoding systems). High-speed selectors for notched cards. Methods for use of digital computing machines to recover information. Ss Se(1947) Ic RCSa

Konrad Zuse, Neukirchen, Germany
Has made Zuse Model IV computer. Se Dc RMSa

ELECTRONIC EQUIPMENT APPLIED TO PERIODIC BILLING

E. F. Cooley, Associate Director, Methods Research,
Prudential Insurance Company of America, Newark, N.J.

(based on a talk at the Association for Computing Machinery meeting, Cambridge, Mass., Sept. 11, 1953)

It seems that in the world of business almost everyone's initial reaction to electronic office equipment has been one of hope and enthusiasm that a new era of higher standards of speed and efficiency is about to begin. It also seems that this initial hope and enthusiasm soon becomes mixed with the fear that the costs and complexities of electronics will make this new equipment impractical for business use. This secondary phase of doubt and fear is a rather dangerous place to be because it is not necessarily a passing phase. There is great danger of business people become permanently stuck at this stage.

Stages of Investigation

In most business organizations the initial contact with electronic office equipment is generally brought about, it seems, by someone reading an article or hearing a talk on how this new marvel of the twentieth century will bring about the millenium of business efficiency. This inspirational approach generates the original enthusiasm for electronics, and the enthusiasm leads to wide investigation of anything and everything related to the field of electronics for business use. Out of this study some knowledge of the equipment is acquired and, more important, some appreciation of the problems involved is developed. At this point the investigator becomes perplexed with such problems as:

1. Are the costs going to be too high?
2. Are the possibilities for errors too great?
3. Is magnetic tape a practical medium for random reference?
4. Can the machines operate long enough at one time to produce a full day's work each day? etc., etc.

Here is where the secondary stage of doubt and fear as to the practicality of the equipment develops.

In the business world, if the potential benefits originally visualized are to be achieved, these problems cannot be ignored but must be solved.

A third and rather obvious stage, in order to get away from the stage of doubt and fear, may be to plunge into the use of electronic office equipment and try it out. We simply replace present equipment by electronic equipment and compare how well and how cheaply the work can be done. For this purpose, we ordinarily try to translate a present procedure into the media and language of the new equipment. But it is my conviction that this method simply will not work satisfactorily, for the difference is likely to be insufficient to demonstrate clearly the potential advantages of the electronic equipment. The main reason for this is that present procedures have been tremendously conditioned over some years by the peculiar abilities of clerks

and present equipment. To simply carry over these peculiarities to the new machines will not permit them to show to any great advantage. So when business executives finally see that drastic changes in procedures are needed to obtain the desired high efficiency from electronic equipment, then the progress toward improved methods is in danger of bogging down.

Aims and Purposes

A logical outgrowth, however, of the third stage is to go back to first principles and to examine the aims and purposes of the work being done under the present procedure without too much regard for the way it is done at present. This fourth stage offers the greatest potential for the application of electronic equipment because it provides a fresh view of how the work might be performed and permits the unhampered use of the peculiar abilities of electronic office equipment.

File Maintenance

For example, when we develop a plan for use of tape processing equipment, we are forced to mechanize an area of work not often mechanized with card equipment. This is the area of file maintenance. With our file on magnetic tape we must use a machine to make changes, whereas with cards, we are likely to find it expedient to send a clerk to pick the cards to be changed and later refile the altered cards by hand. It is true that with a tape system we may punch a card with the new information. But then this card must be converted to tape and matched against the master record tape. A new tape will then be recorded with the new data substituted for the old where changes are necessary, and with all the unchanged data brought forward. This may be considered both a disadvantage and an advantage. It is a disadvantage to have to carry out a long machine operation when the proportion of changes is low; and with a card system we have a choice of manual or machine system and may do whichever we think is more efficient. But with the tape system we have no choice. Fortunately, it is usually found that file maintenance by speedy tape processing machines is a sound operation and that real savings can be made in mechanizing this phase of the work.

Automatic Operation

The peculiar advantage of electronic equipment, and it may be emphasized again and again, is that it is automatic and swift in operation. By virtue of its ability to work speedily from a long sequence of orders stored in the machine itself, lengthy processes can be carried out without any action on the part of the operator; delays and errors, so difficult to cope with satisfactorily in present systems, can be reduced tremendously; and scheduling the work so that machines are uniformly loaded should be much easier than with punch card systems. Of course, the development of the system, and the programming and the coding of orders, is a time-consuming job requiring great care.

The main cost saving from electronic office equipment should come through elimination of persons now doing routine picking and filing or operating semi-automatic machines. Another main benefit to be expected is improved systems owing to the downright necessity of closer study and better planning.

Lower Costs

This leads to a comment which is fundamental to any practical methods consideration. We do not make major methods changes just for the sake of change. We make them to gain real advantages, and it is my contention that the principal advantage that people in business are interested in is LOWER COST OF OPERATION! In business, we are not much interested in speed for speed's sake.

For electronic machines of high speed, high capacity -- and high cost —, few facts with regard to economy have yet been established to my satisfaction. The cost of producing this equipment, taking research and development into consideration, is very high indeed, resulting in high cost to the user. Business users cannot bear these high costs unless there is a real saving to them over any other method. The evaluation and comparison of costs is the main research job of methods men studying electronic possibilities and, I predict, the uncertainties present in this study will continue for some time to come.

Periodic Billing

An important business application for electronic office equipment is "periodic billing". This term is here used in a very broad sense to refer to many tasks related to billing which depend on the same large file of business records. Of course, the prime example I am familiar with is billing of insurance premiums, including related jobs such as computing policy dividends, agent commissions, and policy loan interest, and subsequent accounting for premiums received. Another example is publishers' problems in mailing magazines to subscribers and following up for renewals. A third example is the billing jobs of public utilities.

Billing Insurance Premiums

What are the requirements of billing insurance premiums? In the first place, a policyholder may choose how often he wants his premiums billed: annually, semi-annually, quarterly or, in some circumstances, monthly. The average frequency in our case is two and a half times per year.

Dividends are calculated on the policy anniversary. The policyholder may choose how his dividend is to be used. The popular choice is to use the dividend to reduce the premium; and we use the entire dividend on the policy anniversary. So once a year the amount billed is the "Premium less the Dividend". This means that in a case billed quarterly only three premiums of a particular year are repetitive and the fourth one is different. Most of the remaining policyholders let the dividends accumulate at interest. In these cases the premium <u>is</u> constant. But a supplementary operation is needed to carry forward the amount of dividend to that policyholder's credit.

A great many changes affect the records necessary to carry out billing. The majority are address changes, which run as high as 25 per cent in a year. Other changes are in frequency of premium payments and other contract changes. Because billing, dividend computation, commission payments to agents, and so on, are all tied together and should be handled together, the job gets rather complicated.

Let us try to visualize the application of electronic computers to the job. First, many items in the records must be changed, and these changes must be fed into the system in some way. Our natural inclination is to use punched cards for this purpose. We must work from source documents of various forms, and a manual key operation is still necessary to convert the data into mechanical form. Card form has the advantage that it can be converted to tape form by a semi-automatic process producing input for the computer. And the cards themselves can be used to good advantage in maintaining a file to serve the purposes of "random look-up". Some of our worries about the difficulties of random access to a tape record can be alleviated by keeping this card record file.

All the large scale operations can be performed from the tape records. It is an advantage that all input be by tape for we are forced to mechanical maintenance of the fundamental records; in fact, this should be one of the best sources of saving, both direct and through improved accuracy.

It should be obvious that we must search for combination of allied jobs. We should plan to use the capacities of the new machines as completely as possible. If we are to achieve the greatest economy of operation we cannot preserve barriers between departments with different responsibilities. If we are to have a single record in one area of tape for all data about a policy, then we must get all accounting reports required at the same time, in the same run of the tape.

Although I don't know intimately the publishers' problems and the problems of the utilities, it would seem that their data-handling might be quite similar to ours. They too have a good-sized address file to maintain, with traffic problems; that is, they need up-to-date address data for billing purposes simultaneously with random reference and maintenance reference.

Random Reference

In regard to random reference, one school of thought seems to be that reference for any purpose can be deferred to a periodic search time. Thus if all records are on magnetic tape, the plan would be to run all tape every so often and during this run insert all new data, delete all obsolete data, and extract all desired reference information. It is often suggested that such a run can be made once every twenty-four hours.

Whether such a plan can be considered satisfactory is very much an open question. It is true that <u>most</u> references <u>can</u> be delayed as much as twenty-four hours without serious difficulty. But it is <u>not</u> established that delays causing trouble will be few enough so that this plan can be accepted. The argument seems to boil down to this: the savings through using tape and tape handling devices as the substitute for a real "automatic file" with random reference, have to be so great that powerful objections to the delays will be overbalanced. This means, I think, that faster and more economical tape-handling methods, or some other entirely new method, must be developed. Unless this is done, I am afraid most of us will consider it necessary to maintain card records of some sort. This fact, perhaps, points up again the need for flexibility in changing from card form to tape form and vice versa. In other words, we should not be restricted entirely to either medium but should use whichever fits the job requirements best. Fortunately, development of better card-handling machines is still going on in spite of the emphasis on tape as the modern medium.

Fitting Equipment to the Work

With automatic equipment in which a large number of processing steps are completed in a single operation, it is very important that the maximum be done at once. Therefore, work requirements and machine abilities must fit closely. We have always fitted our work to suit the equipment available. With more automatic equipment, it is even more important that the machine be fitted to the job. In recognition of this, some of the new machine designers are planning to make the machines quite flexible in regard to adding additional capacity when necessary. Only experience will show conclusively whether they have achieved sufficient flexibility to meet our needs.

One question we must resolve is whether business users should expect competition alone to bring about the best designs. Since all manufacturers try to build for average needs for all their potential customers, it is by no means certain that their designs will give a particular company the maximum benefit. Just as other industries have benefited by special designs, custom-built for their purposes, so might we benefit by equipment designed especially for us.

In conclusion, I believe there is great potential in the development of "electronic machines". But let's proceed with eyes wide open and without preconceived notions in regard to great savings of operating cost; and let's realize that lower costs must be attainable in order to justify the profound changes in organization and procedure which will inevitably be necessary.

ROSTER OF ORGANIZATIONS MAKING COMPONENTS

(Information as of Oct. 10, 1953)

The purpose of this roster is to report organizations making components (but not making complete systems) that enter into computing machinery or data-handling equipment or equipment for automatic control and materials handling. Since this would be a very large list if we included all organizations making motors, resistors, magnetic cores, condensers, etc., this roster is not a free listing. For the conditions of listing, see page 39; also the listing is subject to editing for completeness and objectivity; for the abbreviations, see the "Roster of Organizations in the Field of Automatic Computers and Automation".

ROSTER

Alden Electronic and Impulse Recording Equipment Co., Alden Research Center, Westboro, Mass. *A
Facsimile recording equipment and facsimile components. Ma SEE Alden Products Co.

Alden Products Co., 117 No. Main St., Brockton, Mass. *A
General and specific components for digital and analog computing machinery; plug-in components, sensing and indicating components, magnetic delay line units, magnetic storage cores, etc. Ms(300) Me(1930) Ic RMSa

Alfax Paper and Engineering Co., Alden Research Center, Westboro, Mass. *A
Electrosensitive recording papers. Ma SEE Alden Products Co.

Electro Devices Co., 2 Bradley St., Somerville, Boston 45, Mass. *C
Miniature toroidal coils down to 1/8" inside diameter, custom wound by machinery replacing hand winding. Production and experimental quantities. Coil winding machinery. Consulting service re coils and computers. Ss(18) Se(1949) Ic RMCSa

Ferroxcube Corp. of America, East Bridge St., Saugerties, N.Y. *A
Magnetic cores (ferrites) for magnetic storage; magnetic recording heads; etc. Ms(100) Se Ic RMSa

General Ceramics and Steatite Corp., Keasbey, N.J. *C, *A
Magnetic cores for computer components; technical ceramics, insulators, etc. Ls(650) Le(1906) Ic RMSa

Sprague Electric International, Ltd., North Adams, Mass. *A
Capacitors, miniature and other. Ls Ic RMSa

AIR FLOATING, A NEW PRINCIPLE IN MAGNETIC RECORDING OF INFORMATION

Glenn E. Hagen, Logistics Research, Inc.,
Redondo Beach, California

The intelligence and usefulness of a modern automatic computing machine depends almost entirely on how fast and how well it can store and retrieve information. In fact, perhaps the biggest factor holding back full-scale application of automatic computing equipment in business and in other broad fields is the want of a really large memory. For memory in a machine ought to be permanent (keeping information undamaged even if the power fails), be highly reliable, provide easy access, and be vast in extent.

Magnetic drums have recently become popular as a way of storing information for electronic computers. Their greatest drawback, however, is often the lack of large storage capacity. Small-diameter drums have been limited by requiring many channels for information, and so they require many magnetic heads for reading and writing, and in addition a lot of associated switching and amplifying equipment. Large-diameter drums, on the other hand, have been limited as to the density of information that can be recorded on them; and this limitation has been largely due to requirements of exact spacing between the drum surface and the magnetic head. Therefore, efforts to build large-diameter drums that meet spacing requirements accurately have required almost solid metal to achieve close tolerances, and this has led to very heavy and expensive drums.

Theoretically, a magnetic head for reading or writing pulses on a drum is an almost perfect magnetic dipole; and its field strength varies inversely as the cube of the distance. This means that a very small variation in distance between head and drum results in a very large variation in signal from the head. Only by close and constant spacing can information be recorded densely on the drum. If the head position is fixed, the rotating drum must move past it very accurately.

Experimentation known as "Project Halo" taking place at the author's company has led to an apparently new development. The principle is to allow the heads to be movable, actually resting on the drum itself, but positioned and lubricated by a film of air — "air floating" of heads. The heads are movable in their mountings: and a small supply of high-pressure air is allowed to flow out through tiny openings in the mounting near the recording surface. Using this principle, very large drums of light, welded, sheet metal with a magnetic surface can be used, and information can be legibly recorded even more densely than on conventional small, solid drums.

An interesting physical principle is present. Most of us remember the demonstration of Bernoulli's principle in high-school physics, where we found it impossible to blow a piece of paper off the end of a spool by blowing through it. Not only does the air film between head and drum prevent the head from scraping on the drum, but also the suction produced according to Bernoulli's principle prevents the head from bouncing away from the drum. In experiments with the first model (see Figure 1), a three-foot sheet-metal drum known to be several thousandths of an inch out of a true circle, the heads were found to maintain a gap of four ten-thousandths of an inch between head and drum with less than 5% variation observed in the signals produced. The air-floating principle is, of course, equally applicable to magnetic recording on discs, belts, etc.

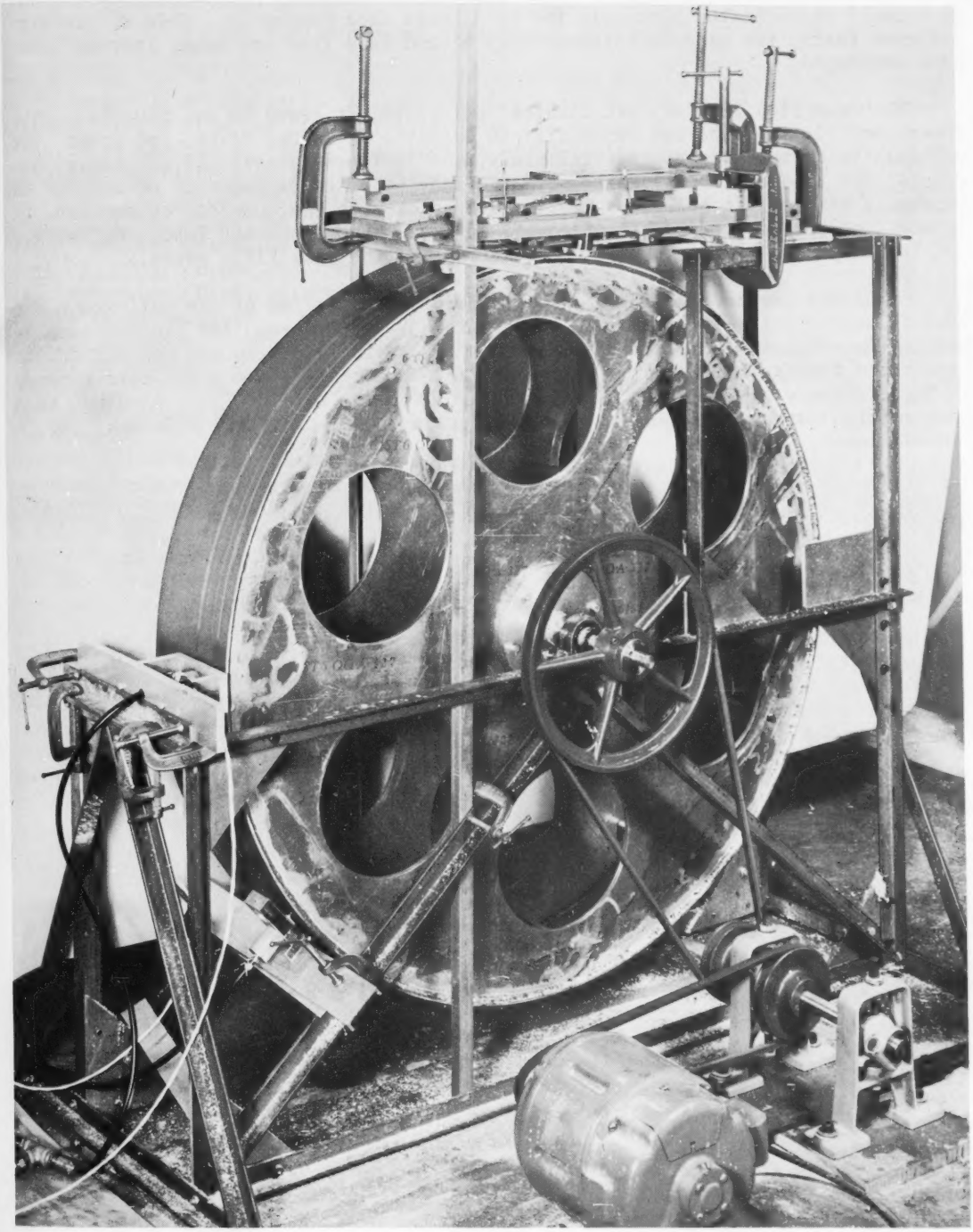

Figure 1. -- This shows the first experimental sheet-metal drum, three feet in diameter, with magnetic coating and the frames for two air-floated heads at the left. One frame is at nine o'clock and one at seven o'clock. This first experimental drum worked perfectly.

The second model of magnetic head employs an auxiliary air pressure produced by a small air-actuated piston in the head mount (see Figure 2). Then if the air pressure fails, the head is automatically backed away from the drum, leaving the drum undamaged.

The "air floating" or "air cushion" principle, it seems to us, removes a sharp upper limit on the size and regularity of magnetic drums and discs, and paves the way for the automatic perpetual inventory, the instantly accessible customers' accounts, the automatic bookkeeping, and the many other large memories needed for the automatic office. It brings us another step closer to the complete automation of information-handling, and this of course may well have a greater impact on business and industry than almost any other development of the past fifty years.

Funds for the development of Project Halo were supplied by the well-known Swedish industrialist and philantropist, Dr. Axel L. Wenner-gren. The project came about as an outgrowth of certain studies for automatic computing and control for the high-speed trains of his design, known as the ALWEG system, now under development in West Germany, described last spring in an issue of "Life". These studies have been carried out by Dr. Wenner-gren's California Group, Logistics Research, Inc.,of Redondo Beach, California.

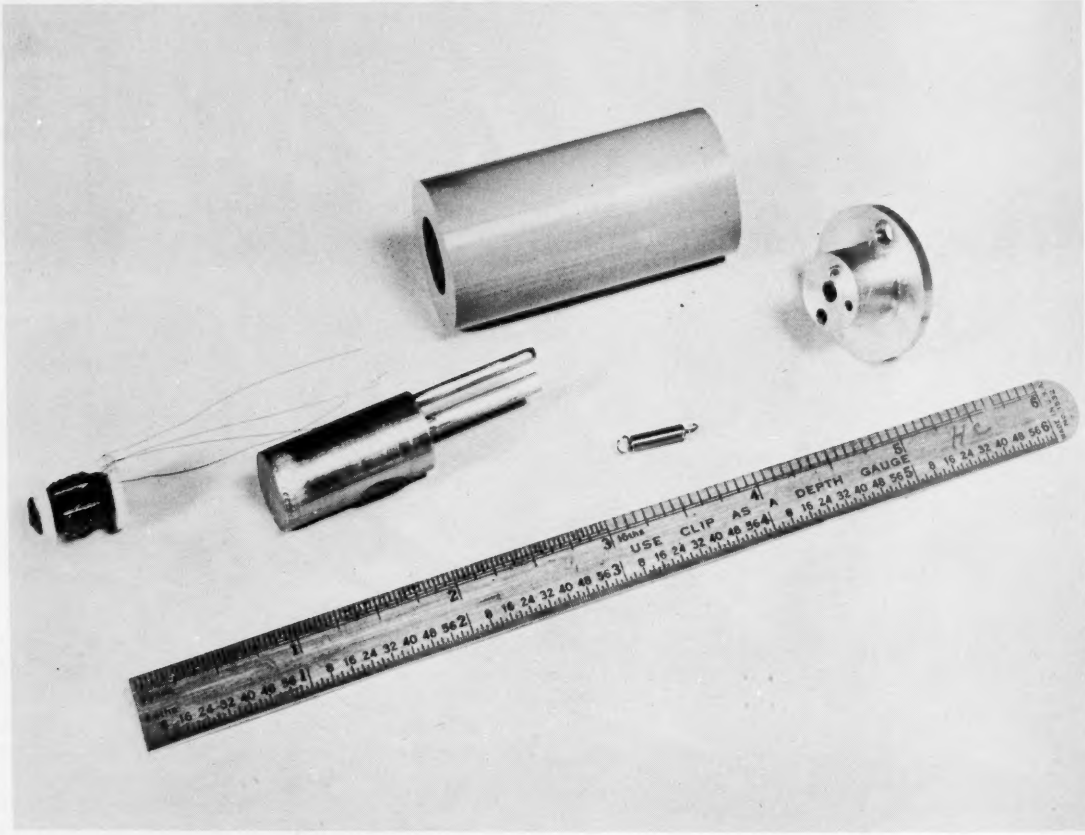

Figure 2. -- The five objects are, fom left to right, the magnetic head, the mount, the aluminum tubular shield, a safety-return spring, and a backing plate. The air flow comes out of two small holes on either side of the head gap when the head is placed inside the mount; and the air flow, besides positively positioning the head at four ten-thousandths of an inch from the drum, also blows away stray magnetic particles happening to come off from the drum surface.

PATENTS

by Hans Schroeder, Milwaukee, Wisconsin

The following is a compilation of patents pertaining to computers and associated equipment, taken from the Official Gazette of the United States Patent Office, issued on the dates indicated. Each item consists of: patent number / inventor(s) / assignee / brief description of the invention.

August 18, 1953: 2,649,542 / P Glass, Chicago, Ill / Askania Regulator Co, Chicago, Ill / Function generator utilizing cathode ray tube principle

August 25, 1953: 2,650,332 / R W Bordewieck, Southboro, Mass / Moore Electronic Labs, Inc, Worcester, Mass / Electronic error correction circuit using DC amplifiers with relays in the output

September 1, 1953: 2,650,760 / G W Bills, Portland, Ore / - / Analog of a power distribution network

2,651,004 / J R Acton, Bunny, England / Ericsson Telephones, Ltd, London, England / Electronic counting and/or selecting arrangement using multi-electrode cold-cathode gas tube

2,651,006 / T S Mederos, Jr, Granby, Conn / Underwood Corp, New York, N Y / Ring counter using cold-cathode grid-controlled tubes

September 8, 1953: 2,651,457 / H P Luhn, Armonk, and R L Johnson, Wappingers Falls, N Y / IBM Corp, New York, N Y / Device for selecting the proper value of trigonometric functions fed to a computer by determining in which octant the angle lies

2,651,458 / H F Bennett, E A Young, and E Hoag, Rochester, N Y / Eastman Kodak Co, Rochester, N Y / Automatic sequence-controlled digital computer

2,651,459 / J M Brady, West Long Branch, N J, A F Spilhaus, St Paul, Minn / United States, Secretary of the Army / Non-electronic analog computer for determining velocity and direction of a craft

2,651,722 / C A Bergfors, Yonkers, N Y / IBM Corp, New York, N Y / Electronic multivibrator using four triodes

2,651,740 / J B Lair, Nutley, N J / Federal Telecommunications Labs, Inc, Nutley, N J / Switching device with a multiple-cathode gas tube

2,651,741 / R J Koehler, Hopewell Junction, N Y / IBM Corp, New York, N Y / Circuit for counting and storage of information on gas-discharge tubes

Joint Computer Conference in December. From the Local Arrangements Committee of the Eastern Joint Computer Conference and Exhibition, scheduled for the Statler Hotel, Washington, D.C., December 8, 9, and 10, 1953,(condensed):

"Information Processing Systems -- Reliability and Requirements", is the general theme of the conference, which is sponsored jointly by the Institute of Radio Engineers, the Association for Computing Machinery, and the American Institute of Electrical Engineers. The indicated attendance is at least 1600 persons. About 26 talks and papers will be given including: "The Use of Electronic Data Processing Systems in the Life Insurance Business" by M.E. Davis, Metropolitan Life Insurance Co.; "Computer Applications in Air Traffic Control", V.I. Weihe, Air Transport Association of America; and "Data Processing Requirements for the Purposes of Numerical Weather Prediction" by J. Smagorinsky, U.S. Weather Bureau.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

Computers and Automation (Insert exact title of publication) published monthly 10 times a year (State exact frequency of issue)

at NEW YORK, N.Y. (Name of post office and State where publication has second-class entry) for OCT 1 1953, 19

1. The names and addresses of the publisher, editor, managing editor, and business managers are:

	Name	*Address*
Publisher	Edmund C. Berkeley and Associates	36 West 11 St., New York 11, N.Y.
Editor	Edmund C. Berkeley	36 West 11 St., New York 11, N.Y.
Managing editor	none	
Business manager	none	

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

Name	*Address*
Edmund C. Berkeley	36 West 11 St., New York 11, N.Y.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

Name	*Address*
none	

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.) xxx

Edmund C. Berkeley
(Signature of editor, publisher, business manager, or owner)

Sworn to and subscribed before me this 28th day of September, 1953

[SEAL] George W. O'Dell

(My commission expires March 24, 1955)

16—18725-4

The purpose of COMPUTERS AND AUTOMATION is to be factual, useful, and understandable. For this purpose, the kind of advertising we desire to publish is the kind that answers questions, such as, What are your products? What are your services? And for each product, What is it called? What does it do? How well does it work? What are its main specifications? Adjectives that express opinion are not desired. We reserve the right not to accept advertising that does not meet our standards.

Every advertisement in this issue, we believe, is factual and objective. For these reasons, we think that the advertising is likely to be worth reading. So far as we can tell, the statements made are reasonable, informative and worth considering.

Following is the index to advertisements:

Advertiser	CA No.	Subject	Page
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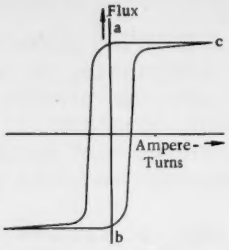
Sylvania Electric Products, Inc.	114	Computer Crystal Diodes	32

If you wish more information about any of the products or services mentioned in one or more of these advertisements, you may circle the appropriate CA No.'s on the Reader's Inquiry Form (see page 35), and send that form to us -- we pay postage (see the instructions). We shall then forward your inquiries, and you will hear from the advertisers direct.

PUT THIS HYSTERESIS LOOP TO WORK FOR YOU!

You probably have been intrigued or are all ready working with the new nickel-iron alloy which has this bi-stable hysteresis curve. It makes possible pulse storage without power, pulse transfers at varying rates, pulse conversions from serial to parallel - while eliminating many vacuum tubes or mechanical devices otherwise necessary.



MATERIAL - a grain-oriented heat-treated alloy of nickel-iron with an extremely rectangular hysteresis loop, magnetically saturable in a given direction by application of a relatively weak magnetizing field. Once magnetized, removal of the magnetizing force leaves core in either state "a" or "b", depending on original direction of magnetization.

SIMPLIFY YOUR DESIGN PROBLEMS- USE THE STANDARD ALDEN STATIC MAGNETIC UNITS- IMMEDIATELY AVAILABLE

in high volume at low cost - Get your lab working - Send for literature and order samples of either --

ALDEN MAGNETIC STORAGE CORES

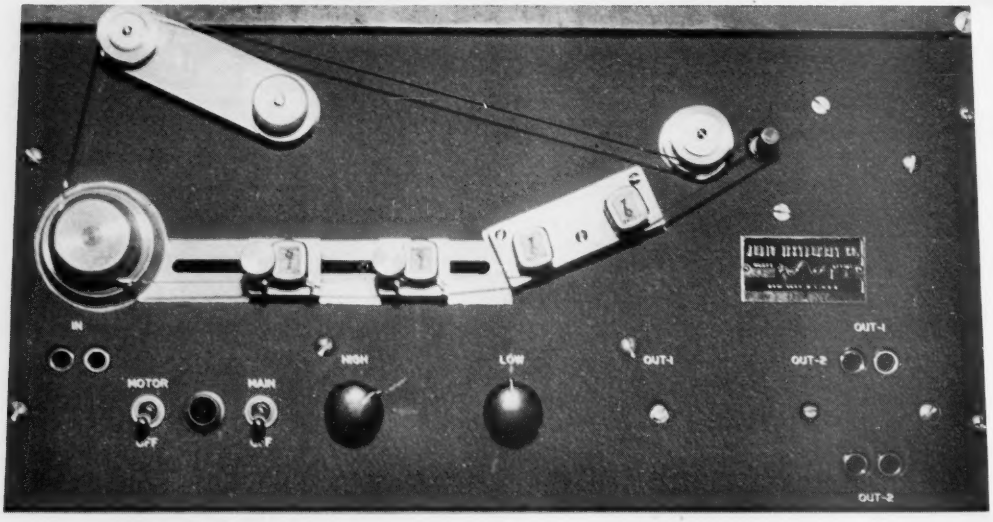
4 Alden Magnetic Storage Cores (#725BWA-1) containing 2-1/8 wraps of 1 mil grain-oriented, heat-treated, nickel-iron alloy, 1/8" wide - with 75, 150, and 200 turns of #36 wire. $5.00*

ALDEN STATIC MAGNETIC MEMORIES OR LINES

2 Alden Static Magnetic Memories (#5100RA) consisting of miniature toroidal core having 3 windings mounted on terminal card with resistor and rectifier coupling circuit. $10.00*

*Prices in accordance with our Standard Component Proposal of 10/15/49, limited to this offer only.

ALDEN PRODUCTS COMPANY (NA-ALD) **114 N. MAIN STREET, BROCKTON MASSACHUSETTS**



THIS IS A TIME-DELAY UNIT. WITH AN INPUT F(t), IT DELIVERS OUTPUTS F(t - X) AND F(t - Y), WHERE X AND Y ARE INDEPENDENTLY ADJUSTABLE FROM 55 TO 180 MILLISECONDS. WE WILL BE HAPPY TO QUOTE ON SIMILAR EQUIPMENT TO YOUR SPECIFICATIONS.

AUDIO INSTRUMENT CO., INC.

133 WEST 14th STREET, DEPT. C-3

New York 11, N. Y. Write for Details

FOR APPLICATIONS IN RADAR, TELEMETERING, DIGITAL COMPUTING, TELEVISION, NUCLEAR PHYSICS

Coincidence Detector, Type 1201B, another of the basic elements in Burroughs' line of "Unitized" Pulse Control Equipment.

"Unitized" Pulse Control Equipment

permits fast, easy readaptation of electronic test circuits

Speedy assembly of electronic testing equipment is one big advantage you gain when you use versatile Burroughs pulse control units . . . but there is another tremendous advantage that *only* "Unitized" equipment offers. Since each Burroughs unit performs just *one basic operation*—such as generating, counting, mixing, gating, or delay—it's easy to *reassemble* equipment for a *different* project when one set of electronic tests is completed. You simply make a block diagram of the new circuit needed and rearrange the cables to correspond to your diagram. This flexibility permits you to quickly perform tests which otherwise might require a very long time or not be undertaken at all.

SIMPLY "PLUG IN"
BURROUGHS COINCIDENCE DETECTORS

Both of the coincidence detectors offered by Burroughs demonstrate the practical one-basic-function principle that makes Burroughs "Unitized" Pulse Control Equipment so suitable to your needs.

Burroughs Coincidence Detector, Type 1201B (shown here), is designed to detect coincidence between the output signal of a flip-flop and 0.1 microsecond pulses. Two inputs are provided for each unit. One accepts 0.1 microsecond pulses with amplitudes of 12 volts or more. The other accepts the output of Burroughs Flip-Flop, Type 1101C or equivalent.

Burroughs "Unitized" pulse control assemblies have been in constant use for more than two years. Their proved dependability has led to their use by many leading electronic research organizations, including: Massachusetts Institute of Technology, Consolidated Engineering Corporation, The Catholic University of America and Magnetics Research Company.

For full information on Burroughs "Unitized" Pulse Control Equipment, write or call Department 17C, Electronic Instruments Division, Burroughs Corporation, 511 North Broad Street, Philadelphia 23, Pa.

PULSE GENERATORS
COINCIDENCE DETECTORS
PULSE DELAYS
FLIP-FLOPS
PULSE GATERS
CHANNEL SELECTORS
MIXERS

ELECTRONIC INSTRUMENTS DIVISION
Burroughs

THE BEST KNOWN NAME IN OFFICE MACHINES

From: Edmund C. Berkeley and Associates
Publishers of COMPUTERS AND AUTOMATION
36 West 11 St., New York 11, N. Y.

ADVERTISING

1. What is "COMPUTERS AND AUTOMATION"? It is a magazine published monthly, except June and August, containing articles and reference information related to computing machinery, robots, automatic controllers, cybernetics, automation, etc. One important piece of reference information published is the "Roster of Organizations in the Field of Computers and Automation". The basic subscription rate is $4.50 a year in the United States and Canada. Single copies are $1.25. The magazine was called THE COMPUTING MACHINERY FIELD until the March, 1953, issue; prior to that issue, it was published less often than ten times a year.

2. Who are the logical readers? The logical readers of COMPUTERS AND AUTOMATION are some 3000 persons who are concerned with the field of computers and automation. Many people are entering this field all the time. These include a great number of people who will make recommendations to their organizations about purchasing computing machinery and similar machinery. We have been carefully gathering the names and addresses of these people for some time and believe we can reach them. The print order for the November issue is 1400 copies. The paid subscriptions on September 10, 1953 were a little over 970.

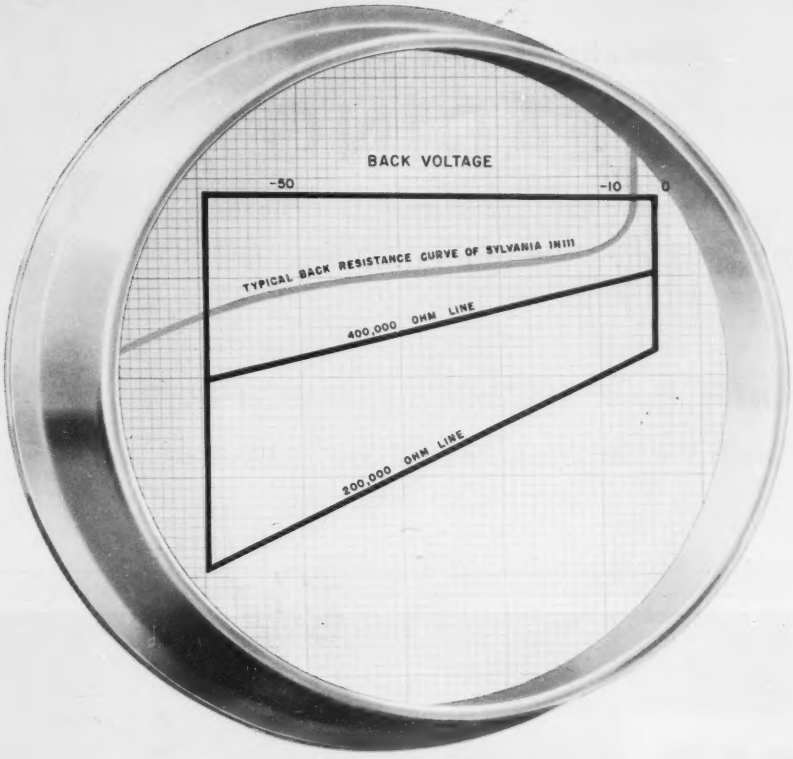
3. What type of advertising does COMPUTERS AND AUTOMATION take? The purpose of the magazine is to be factual and to the point. For this purpose the kind of advertising wanted is the kind that answers questions factually. We recommend for the audience that we reach, that advertising be factual, useful, interesting, understandable, and new from issue to issue. We have had a number of comments expressing satisfaction with our style of advertising.

4. What are the specifications and cost of advertising? The next issue of COMPUTERS AND AUTOMATION will be in Dec. 1953. It will be on pages 8½" by 11" and will be produced by photooffset. If possible, the company advertising should produce final copy, which should be actual size and assembled, and may include typing, writing, line drawings, printing, screened halftones, etc. -- any copy that may be photooffset without further preparation. If inconvenient to produce this, we will take rough copy and arrange with the printer to prepare it; there will be small additional charges in this event. Display advertising will be sold in units of full pages (ad size 7" by 10", basic rate $100), and horizontal half pages (ad size 7" by 5", basic rate $55); back cover, $180; inside back cover $125. Classified advertising will be sold by the word (30 cents a word), with a minimum of ten words. The following discounts will apply to display advertising excluding cover space: 20% for a company with less than 50 employees and a publisher of books; 40% for a company of less than 20 employees. The closing date is Nov. 10 for the December issue. (It is expected that advertising rates will be increased for advertising placed after Nov. 30.)

5. Who are our advertisers? Our advertisers in recent issues have included the following companies, among others:

Alden Products Co.
Burroughs Corp.
Computing Devices of Canada, Limited
Consolidated Engineering Co.
Electronic Associates, Inc.
General Ceramics and Steatite Corp.
International Business Machines Corp.
Laboratory for Electronics
The Macmillan Co.
Monroe Calculating Machine Co.
George A. Philbrick Researches, Inc.
Potter Instrument Co.
Remington Rand, Inc.
Sylvania Electric Products, Inc.

Sylvania Computer Crystal Diodes



1N111
1N112
1N113
1N114
1N115

All Dynamically Tested at 55° C. For High Back Resistance and Stability

Sylvania Types 1N111, 1N112, 1N113, 1N114 and 1N115 were designed specifically for computer use. All Sylvania's Computer Diodes are tested at raised temperatures simulating actual operating conditions. To insure maximum stability and life, all units are tested for evidence of drift and hysteresis. Each diode is hermetically sealed in glass and is designed so that it may conveniently be soldered or clipped into a circuit.

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In Canada: Sylvania Electric (Canada) Ltd., University Tower Building
St. Catherine Street, Montreal, P. Q.

Sylvania Electric Products Inc.
Dept. 3E 6211, 1740 Broadway, New York 19, N.Y.

Please send me data sheets on Sylvania Computer Crystal Diodes.

Name_____

Address_____

City_____ Zone____ State____

Automatic Electronic Equipment for

READING

Printed or Typewritten Characters
and converting them into coded electrical impulses

INTELLIGENT MACHINES RESEARCH CORP.

134 South Wayne St., Arlington, Va. JAckson 5-7226

FXC first in ferrites...

FERROXCUBE CORE MATERIALS ARE FINDING SUCCESSFUL APPLICATION
IN MEMORY CIRCUITS REQUIRING RECTANGULAR HYSTERESIS LOOP
TOROIDS, IN BLOCKING OSCILLATOR CIRCUITS, IN PULSE TRANSFORMERS,
IN DELAY LINES AND IN RECORDING HEADS

MAY WE SEND YOU APPLICATION DATA IN YOUR PARTICULAR FIELD OF INTEREST?

FERROXCUBE CORPORATION OF AMERICA

• A Joint Affiliate of Sprague Electric Co. and Philips Industries, Managed by Sprague •

SAUGERTIES, NEW YORK

MONROBOT ELECTRONIC CALCULATOR

The MONROBOT is a general purpose digital computer, compact, ruggedized, reliable and reasonably priced. In the MONROBOT, decimal numbers are used. Since twenty digits are available, with a centrally located decimal point, there is no need for scaling or setting of decimal point. Neither overflow nor translation techniques are necessary. Orders are written for the calculator in virtually their original algebraic form.

Neither highly trained personnel nor extensive training effort are needed for the MONROBOT. Keyboard and automatic tape operations are counterparts of the simple programming procedures. Average office personnel become familiar with MONROBOT operation the first day. It prints out results on 8-1/2" wide paper roll, or perforates a paper tape as desired.

MONROBOT V is complete in one desk-size unit, ready to plug in and perform. MONROBOTS can be supplied with capacities to suit special requirements, avoiding excess investment for unnecessary facilities.

MONROBOT CORPORATION

MORRIS PLAINS **NEW JERSEY**

A SUBSIDIARY OF MONROE CALCULATING MACHINE COMPANY

COMPUTERS AND AUTOMATION BACK COPIES:

ARTICLES: May: Compiling Routines — Grace M. Hopper, Remington Rand
Mechanical Translation — Andrew D. Booth, Birkbeck College, London
Medical Diagnosis — Marshall Stone, University of Chicago
July: Machine Translation — Y. Bar-Hillel, Mass. Inst. of Technology
Robot Traffic Policemen — George A.W. Boehm, Science Editor, Newsweek
How to Talk About Computers — Rudolf Flesch, Author of "Art of Plain Talk"
September: The Soviet Union: Automatic Digital Computer Research — Tommaso Fortuna
Digital Computer Questionnaire — Lawrence Wainwright
"How to Talk About Computers": Discussion — G.G. Hawley and others
October: Computers in the Factory — David W. Brown
The Flood of Automatic Computers — Neil Macdonald
The Meeting of the Association for Computing Machinery in Cambridge, Mass., September, 1953 — E. C. Berkeley

REFERENCE INFORMATION: Roster of Organizations in the Field of Computers and Automation
Roster of Organizations Making Components • List of Automatic Computers
Who's Who • Books and Other Publications • Glossary • Patents

Price of back copies, $1.25 each -- or a subscription (see rates on page i) may be specified to begin with any issue from October 1952 to date.

Edmund C. Berkeley and Associates, 36 West 11 St., New York 11, N. Y.

REPLY FORMS

Instructions: (1) Cut out on dashed lines below. (2) Take an ordinary envelope. (3) Fasten this label on front of envelope (4) Complete this form, put it in the envelope, seal and mail.

BUSINESS REPLY LABEL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

4¢ Postage Will Be Paid By—

EDMUND C. BERKELEY AND ASSOCIATES
36 West 11th Street
New York 11, N. Y.

FIRST CLASS
PERMIT NO 1680
Sec. 34.9, P. L. & R.
NEW YORK, N. Y.

IDENTIFICATION

Name (please print).....
Address.....
Organization (& address)?.....
Title?.....

Please fill in completely

WHO'S WHO ENTRY FORM

Year of Birth?.....

MAIN INTERESTS:
( ) Design ( ) Construction ( ) Applications
( ) Sales ( ) Electronics ( ) Mathematics ( ) Business
( ) Programming ( ) Other (specify):.....

College or last school?.....

Years of experience in computing machinery field?.....

Occupation?..... (Enclose more Information about yourself if you wish — it will help in your listing.)

READER'S INQUIRY FORM

Please send me additional information on the following subjects for which I have circled the CA number:

1	2	3	4	5	26	27	28	29	30	51	52	53	54	55	76	77	78	79	80	101	102	103	104	105	126	127	128	129	130
6	7	8	9	10	31	32	33	34	35	56	57	58	59	60	81	82	83	84	85	106	107	108	109	110	131	132	133	134	135
11	12	13	14	15	36	37	38	39	40	61	62	63	64	65	86	87	88	89	90	111	112	113	114	115	136	137	138	139	140
16	17	18	19	20	41	42	43	44	45	66	67	68	69	70	91	92	93	94	95	116	117	118	119	120	141	142	143	144	145
21	22	23	24	25	46	47	48	49	50	71	72	73	74	75	96	97	98	99	100	121	122	123	124	125	146	147	148	149	150

FERRITE
MEMORY CORES

General Ceramics & Steatite Corporation has now supplied many hundreds of thousands of memory cores for application in high speed digital computer memory circuits.

The application of the ferrite core has resulted in an improvement in access time as much as 30%, when compared with a storage tube memory system. The incidence of error has been reduced to a few per week.

We offer these cores as rings from stock; our part No. 7-304 — OD .030"; ID .050"; thickness .025". Other sizes can be supplied to your specifications. Bodies of Ferramic S-1 and Ferramic S-2 are available having the following properties:

INITIAL PERMEABILITY (1 MEGACYCLE)	mu_o	FERRAMIC S-1 40	FERRAMIC S-2 49
MAX. PERMEABILITY (DC)	mu max.	515 (1000 gauss)	1300 (1360 gauss)
SATURATION FLUX DENSITY (DC) gauss	B_s	1780	2000
RETENTIVITY (DC) gauss	B_r	1590	1760
COERCIVE FORCE (OERSTEDS)	H_c	1.5	.07
SWITCHING TIME (MICROSECONDS)	—	1	2
B_r/B_s RATIO	—	0.9	0.85
MAX. SQUARENESS RATIO $\Phi(-I_m)/\Phi(I_m)$	R_s	0.8	0.8

General Ceramics & Steatite Corp.

KEASBEY • NEW JERSEY

TELEPHONE: VALLEY 6-5100

LFE
solid delay lines stop time

Available for video integration, computers, time markers, moving target indication, etc.

LFE Solid Delay Lines offer important advantages in obtaining precise delay intervals for pulse or modulated signals:

Wide ranges of delay	Smooth pass band
Low attenuation	Wide temperature range
Low spurious response	Minimum size and weight
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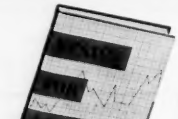
For complete information, write: SPECIALTIES DIVISION

LABORATORY for ELECTRONICS, INC.
75-9 PITTS STREET • BOSTON 14, MASS.

How do you make decisions?



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Address .....

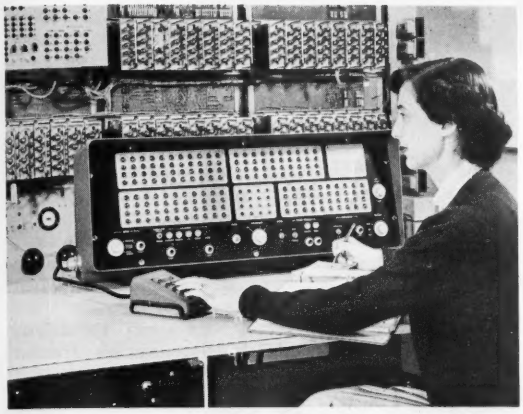
(On-approval offer good only within continental U.S.A.)

4080-WORD MEMORY DRUM

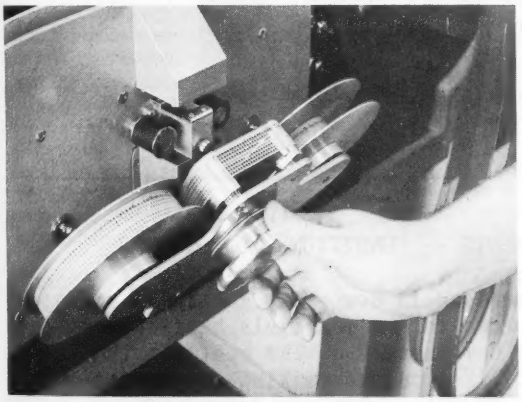
DECIMAL-NUMBER OPERATION

CONTINUOUSLY DISPLAYED REGISTER CONTENTS

B-REGISTER FOR CODING SIMPLICITY, COMPUTATIONAL SPEED



Control Console displays contents of all registers during computation and permits problems to be stepped at will for checking. Input unit (left) allows manual insertion of individual numbers or commands for corrections or tests.



Optical reader and punched paper tape may be used for input to computer with modified electric typewriter for output. Other systems may be assembled around standard punched-card equipment for both input and output.

Basic unit of the many possible Consolidated Data Reduction Systems is the Model 30 - 201 Automatic Digital Computer. Above are four of this computer's many features. Large capacity, plus the rate at which words are extracted from the memory drum, gives the over-all systems an appreciable speed advantage. A single - address code is used, with a total of 42 basic commands, and most operations are executed at 500 per second. Average access time to either numbers or commands in the main memory is 8.5 milliseconds; a "quick-access" memory makes 80 words accessible in only 0.85 milliseconds.

Coding is greatly simplified by the unique "B - Register", which allows the same special command, stored in the memory only once, to be executed many times during a computation while being automatically and only temporarily modified each time by a different number in the B-Register.

Consolidated Engineering Corporation, going beyond the initial steps of design and construction of Data Reduction Systems, installs the equipment and trains operating personnel, maintains a complete mathematical staff and competent maintenance service. A complete system now operating at our Pasadena laboratories is available for inspection. We will be pleased to demonstrate its applicability to specific problems. Inquiries are invited.

The Computer Division

CONSOLIDATED ENGINEERING
CORPORATION

300 NORTH SIERRA MADRE VILLA, PASADENA 15, CALIFORNIA

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Single and Multi-Channel
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Designed for parallel-track pulse recording and reproduction of data on magnetic tapes or drums in high speed digital recorders. Features include: high level performance, relative thinness, interchangeability and adaptability for fabrication of multi-channel assemblies by stacking. Available as narrow or wide gap single channel heads or as six or 21-channel assemblies.
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ROSTER OF ORGANIZATIONS MAKING COMPONENTS -- CONDITIONS FOR LISTING

Any organization making components that can be used in computing machinery or data-handling equipment or equipment for automatic control or materials handling may be listed in the "Roster of Organizations Making Components". The cost for the listing is $3 a line with a minimum of four lines; if a company making components advertises in the same issue, it will receive a four-line listing free. The listing will be subject to the customary editing for completeness and objectivity.

If you are interested in a listing for your organization, please supply the information for a Roster entry (see p. 22) and write to Edmund C. Berkeley and Associates, Publishers of COMPUTERS AND AUTOMATION, 36 West 11 St., New York 11, N. Y.

A REPORT FROM THE LABORATORIES OF REMINGTON RAND ON

ELECTRONIC DEVELOPMENTS FOR BUSINESS AND SCIENCE

Much of the popular talk about "giant brains" has actually obscured the work which electronic computing systems *are doing now* . . . to answer the pressing problems of business record keeping and control as well as scientific and mathematical computations.

An electronic computer system can process a large volume of data faster and more economically than any other method. Only one operation is required for a complicated program of computing, selecting and filing information. Routine decisions can be made automatically on the basis of instructions given the system. Exceptional conditions requiring management attention can be automatically signaled.

Remington Rand presents here some practical electronic devices which may be applied profitably today by business and science:

High-speed tallying

This Fac-tronic storage system is a new Remington Rand development. For John Plain & Co., a large wholesale mail order firm, it produces up-to-the-minute inventory analysis by item under the most demanding conditions of seasonal and shifting demand. Just ten order clerks—working at 10-key input systems to a magnetic drum memory—can provide accurate tallies of orders for 12,000 different items; make available complete tallies each day or anytime needed; and accommodate approximately 80,000 order lines per day.

Punched-card computers

New standards of speed and simplicity in punched-card procedures have been set by our new Punched-Card Electronic Computer. This system eliminates many time-consuming operations on other machines . . . produces *complete* cards which are ready for *immediate* tabulation of records and reports.

Big electronic computers

Remington Rand offers two distinct families of big computing systems: 1) The UNIVAC all-purpose system is designed primarily for business record keeping; 2) the ERA 1101, 1102 and 1103 general purpose systems are designed for scientific or mathematical computations.

Solving problems *today!*

Right now, electronic systems are working economically on such practical tasks as—billing and accounting, statistical reports and forecasts, planning studies and scheduling, production and inventory control, payroll and cost accounting records, pricing analyses, engineering design and many data-reduction applications.

Outstanding UNIVAC features are: processing of alphabetical as well as numerical data without special coding and decoding operations; high speed in sorting, collating, and filing as well as computing and decision making; tremendous speed of input and output by magnetic tapes; and built-in circuits for *automatic self-checking*, unique among large-scale data-handling systems.

ERA systems have an enviable record for high-speed solutions to complicated mathematical problems such as data reduction, systems simulation, planning studies, and control in real time. The new ERA 1103 provides very high internal speed, large storage capacity, and flexibility to surpass other systems of the same character. The 1103 also provides versatility of input and output—by teletype tape, magnetic tape, punched cards (80 or 90 columns), line printer, electric typewriter, and oscilloscope.

Custom-made systems

Air traffic control is just one example of the many special purpose electronic computer systems created by Remington Rand. This high-speed system receives via teletype such flight facts as: departure time, destination, route, fuel load, payload, and other pertinent data. In less than half a second, the system electronically compares the facts on each flight with as many as 2,000 flight plans it has stored in its magnetic-drum memory. It then revises, cancels, or brings the information up to date according to current conditions. The system completes the process by teletyping the required results back to the sending station . . . without human handling.

System designing

Remington Rand specialists analyze *your* needs in scheduling, process control, machine control, inventory control, data reduction, automatic filing, or other problems. A system may be created for you from standardized "building block" components, or we can make components to meet your needs.

Computing services

Through two electronic-computing centers, Remington Rand offers you the advantages of the UNIVAC and the ERA systems on a service-bureau basis. The centers have solved problems of such diverse types as complex accounting and record keeping, involved statistical and personnel studies, and cross-indexing of complex catalogs, books, and timetables.

One of the recent jobs handled by the UNIVAC center was a study of seasonal sales patterns and advertising timing. The Bureau of Advertising wanted a projection of 1954 monthly buying trends for 28 specific lines of merchandise in stores across the nation. To do the calculations on this series of 336 trend lines with desk calculators would have taken about 200 man-hours. The UNIVAC computer made all the calculations in just 3 and ½ minutes.

Let us show you how to save time and money on one-time jobs, deadline jobs, unusual jobs, and even routine jobs.

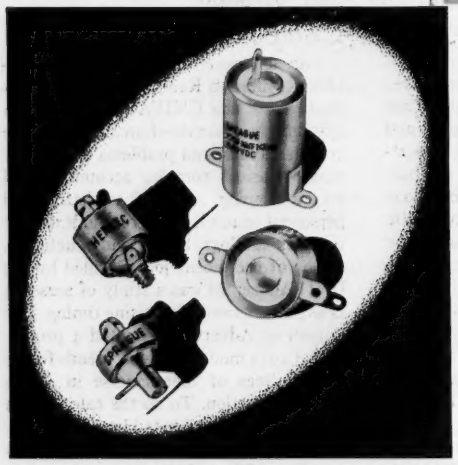
Management seminars

Through seminars and training courses, Remington Rand will help you learn how to apply electronic methods to your needs. In this way your organization can determine for itself the computer system needed—and the economic considerations involved—including choice between our rental or purchase plans. Remington Rand will also train your employees to operate the system efficiently. For more information, write to Remington Rand Inc., Electronic Computer Dept., Room 1414, 315 Fourth Avenue, New York 10, New York.

HERMETICALLY SEALED METAL-ENCASED

PRECISION CERAMIC CAPACITORS

with HIGH STABILITY for critical circuits



Sprague, on request, will provide you with complete application engineering service and assistance for optimum results in the use of precision ceramic capacitors.

IF YOUR problem is one of circuit stability in precision oscillators or of close capacitance tolerances in electronic instrumentation, have you investigated the advantages of Sprague-Herlec Precision Ceramic Capacitors?

These unique capacitors offer not only top capacitance and temperature stability but stability with applied voltage, uniform retrace characteristics, and high "Q". They are available in capacitance tolerances as close as ±1% and temperature coefficient tolerances as close as ±10 ppm/°C in regular production quantities.

Mechanically, they are small in size, sealed against atmospheric humidity, and resistant to vibration and shock. Standard operating temperature range is from −55°C to +85°C.

Sprague-Herlec Precision Ceramics are available in all standard temperature coefficients from P100 to N750, and can also be manufactured to any exact intermediate coefficient required for balancing other circuit constants. When used in combination with Sprague Durameg® Accurate Wire-Wound Resistors, it i. possible to achieve stability heretofore impracticable in mass-produced electronic equipment. Sprague can furnish you either these R-C network components or complete network subassemblies to meet your tolerance requirements.

For complete details on Sprague-Herlec Precision Ceramic Capacitors, write for Engineering Bulletins 603-B and 607-A to Sprague Electric Co., 377 Marshall Street, North Adams, Mass. or Herlec* Corporation, Grafton, Wisconsin.

*THE HERLEC CORP. IS A WHOLLY-OWNED SUBSIDIARY OF THE SPRAGUE ELECTRIC CO.

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